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DOCUMENT RESUME

ED 191 910 TM 800 534

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TITLE	Statistical Power with Group Mean as the Unit of Analysis.
INSTITUTION	Ohio Univ., Athens.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Apr 80
GRANT	NIE-G-78-0072
NOTE	251p.: Some of the computer printouts contain light print.
EDRS PRICE	MF01/PC11 Plus Postage.
DESCRIPTORS	*Analysis of Variance: Behavioral Science Research: Elementary Secondary Education; Error of Measurement: *Hypothesis Testing: *Mathematical Models: Probability: Research Design: *Sampling: *Statistical Significance
IDENTIFIERS	F Test: Generalizability Theory; *Power (Statistics): *Unit of Analysis Problems

ABSTRACT

Focusing on the probability that differences will be found among sample treatment means when such differences do exist among the population means, this paper discusses the power of the F-test. The basic question concerns the use of analysis of variance (ANOVA) and the number of units to be randomly sampled to have a high probability of detecting meaningful differences among the treatment level means, where the units of analysis are independent group means found by averaging over related scores. The Fisher's F-test is used to establish differences among treatment level means. The unit of analysis is the group mean where there is a relationship among members of the group (e.g. in a classroom situation). Methods used to calculate power for independent entities (e.g. students) are reviewed, as well as a fabricated example problem to provide insight into the group formulas which are developed. (RL)

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STATISTICAL POWER WITH GROUP MEAN AS THE UNIT OF ANALYSIS[1]

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TM 800534

Final Report to the National Institute
of Education, April, 1980

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[1] The preparation of this paper was supported in part by the National Institute of Education, contract number NIE-G-78-0072. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement should be inferred.

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PREFACE

This is a didactic paper written for behavioral science researchers who are primarily interested in planning educational experimental research studies where generalizations are to be made at the group (e.g. school or class) level. The basic question answered in this paper is: In an analysis of variance, ANOVA, where the units of analysis are independent group means, found by averaging over related scores, how many such units should be randomly sampled in order to have a high probability of detecting meaningful differences among the treatment level means? Cohen (1977, p. xiv) has stated "that the typical behavioral scientist approaches applied statistics with considerable uncertainty (if not actual nervousness), and requires a verbal-intuitive exposition, rich in redundancy and with many concrete illustrations." My own experiences in working on research projects with behavioral scientists have led me to completely agree with Cohen. Therefore, I have tried to provide concrete examples and detailed background information throughout this paper. For example, in Section 2 I review methods used to calculate power for independent entities (e.g. students), and in Section 3 I use a fabricated example problem (subsection 3.3) to provide the reader with insight into the group formulas that were developed earlier in this section. Importantly, in Section 5, six examples are provided to indicate how power may be calculated, and sample size selected, for educational field experiments. The first example is a step-by-step illustration with the other examples primarily based on real educational research studies.

I first became interested in the problem of power and unit of analysis when I was working on a study where classes were the units of analysis (Eldridge, Witmer, Barcikowski and Bauer, 1977). In this study we were able to randomly assign classes to treatments and we wanted to have some idea of the power of our statistical test. In consulting the literature I found that this problem was not discussed and that only Peckham, Glass, and Hopkins (1969) even mention it, but under conditions were subjects are independent within groups--an artificial case where one would not want to use the group mean as the unit. What I wanted was to be able to find power when groups were the units of analysis and where there was a relationship among the entities that made-up each group.

To solve this problem I originally proposed a Monte Carlo study where groups of related subjects were to be generated on a computer. When this proposal was accepted by the National Institute of Education, I immediately wrote a power program ("RPOW", Appendix I) that would generate power values for groups. The reason I was forced to study this problem using a Monte Carlo approach was that I had been unable to determine mathematically what the standard error of the mean would be when group mean was the unit of analysis. However, shortly after the Monte Carlo program was generating its power values, and while I was on leave in Nigeria as a Visiting Fulbright-Hays Professor at the University of Ife, I found a mathematical solution for the standard error of the mean of group means (see Section 3). This led to a program ("MBAR", Appendix 1) that would allow the generation of power values using mathematical formulas. (Incidently, I have since discovered that the formula I arrived at for the standard error of the group mean was originally derived by Harris in 1913, and that its finite population form is attributed to Hansen and Hurwitz

(1942). I am still puzzeled as to why I did not discover the latter formula in the sample literature, under cluster samples, before I invented the wheel again.)

The next step that I took was to see if I could establish some feel for what the relationship among students in classes might be. This led me to consider Haggard's (1958) book on the intraclass correlation. Here I soon discovered that the intraclass correlation was an excellent way to measure the relationship among subjects in a class, and I decided to use it on data from real classes. In this manner I found that in many cases an intraclass correlation of .20 was a reasonable benchmark to use in helping to calculate power, and I was also able to speculate on other values of interrelationship that might be found, depending on a number of conditions--see Example 1, Section 5. At this point I was able to establish a fairly simple procedure, based on well known methods of finding power, that will enable educational researchers to use groups as units in field experiments where there will be a high probability of detecting postulated treatment effects. This procedure is described in what follows.

STATISTICAL POWER WITH GROUP MEAN AS THE UNIT OF ANALYSIS[1]

Robert S. Barcikowski

Ohio University

Final Report to the National Institute
of Education, April, 1980

EXECUTIVE SUMMARY

This section was written in order to provide educational researchers with an idea of the aplicability of the work done in this paper to practical problems in education. It contains material that was taken verbatim from the introduction to this paper, Section 1, and the section on the use of the paper's equations and tables through examples, Section 5. The Executive Summary is intended for distribution to behavioral scientists who might be interested in reading the whole paper.

Introduction

In educational research and evaluation the mean of a group (e.g. a class of students) frequently is or should be used as the unit of analysis v

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[1] The preparation of this paper was supported in part by the National Institute of Education, contract number NIE-G-78-0072. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement should be inferred.

in field experiments. The importance of this point has been stressed by several authors, e.g. Bock & Wiley (1967); Cronback (1976); Glending (1976); Poynor (1974). The purpose of this paper is to aid researchers in designing field experiments that have enough units (groups) to detect "meaningful differences" among an experiment's treatment levels (e.g. among different methods of teaching arithmetic or reading). Meaningful differences among treatment levels are described in detail in a book by Cohen (1977), but they are basically--expressed quantitatively as differences among the treatment level population means; established beforehand by the experimenter on the basis of theory and/or past experience; estimated by the mean differences among the sample treatment means; and, if found to exist, usually indicate that some action must be taken and/or changes made. Examples are illustrated later in this paper in Section 5. The statistical tool primarily used to establish differences among treatment level means is Fisher's F-test. Therefore, the focus of this paper is on the probability that differences will be found among sample treatment means when, indeed, such differences do exist among the population means. The latter probability is known as the power of the F-test. This focus differs from other discussions of power analysis in that the unit of analysis considered here is the group mean where there is a relationship among the members of the group; such a relationship is typically found in a classroom situation. That is, the basic question answered in this paper is: In an analysis of variance, ANOVA, where the units of analysis are independent group means, found by averaging over related scores, how many such units should be randomly sampled in order to have a high probability of detecting meaningful differences among the treatment level means?

Example 1

This example was written in a step-by-step manner for those educational researchers and evaluators who are unfamiliar with statistical power analysis. The design considered in this example is the simplist one possible where we have one factor and two levels. The design is illustrated in Figure 1 where the factor is simply called Factor 1 and the levels are labeled treatment and control.

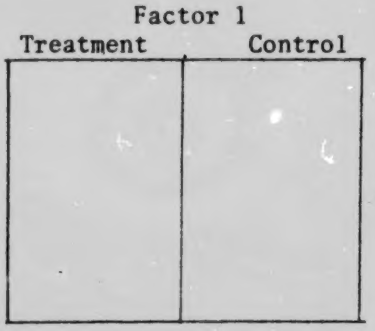

Figure 1: A Simple One Factor Two Level Design

The researcher is able to randomly assign classrooms to each of the factor levels, but he cannot randomly assign pupils to the two conditions. Therefore, he would like to know how many classrooms should be randomly assigned to each factor level--the steps he should take follow.

STEP 1: Determine the level of significance.

Example: In this example the researcher selected .05 as the level of significance (α).

STEP 2: Determine the magnitude of the treatment effect (f): small, $f = .10$, medium, $f = .25$; and large, $f = .40$. (See section 2.1, under Cohen's Tables, for a further discussion of effect size (f).)

Example: Effect size was set at $f = .25$.

STEP 3: Determine the strength of the interrelationship (ρ) among the students in a class. To select ρ the researcher should take into consideration how and when the class was found and how long the treatments will last. The following table should serve as a guide in selecting ρ.

Group Formation		Treatment	
When	How	Length	Interrelationship (ρ)
new	close to/or random	short	.05-.10
new	close to/or random	long	.10-.20
new	by ability	short	.50-.60
new	by ability	long	.70-.80
old	close to/or random	short	.10-.20
old	close to/or random	long	.10-.20
old	by ability	short	.70-.80
old	by ability	long	.70-.80

Example: In this example the researcher has a class that has been together for more than one month, i.e. it is old; and is balanced with respect to ability, i.e. close to random; and the treatment would take less than one month, i.e. it is short. Therefore, the researcher selected $\rho = .20$ to represent the interrelationship among the students in a class. (If classes are homogeneously grouped by ability see example 5.)

STEP 4: Determine the approximate class size.

Example: Most of the classes available to the researcher contain about twenty students.

STEP 5: Determine the minimum power for this design, i.e. the probability of rejecting the null hypothesis when it is false.

Example: The researcher decided that if there were differences between the factor levels, then he would like to detect them with probability equal to or greater than .90.

STEP 6: Use the tables presented here, Cohen's tables, or Tang's Charts to help determine an appropriate number of groups (classes) per treatment.

Example: Tables in Appendix 4: Using the parameters found in the preceding steps, i.e. $\alpha = .05$, $f = .25$, $\rho = .20$, entities per unit (class size) = 20, minimum power = .90, and the fact that there are two treatment levels, the researcher can turn to Table 4.5.17 in Appendix 4 to find the 25 classes (units) per treatment level will yield power of .95 and that 20 classes per treatment level will yield power of .89.

Example: Cohen's Tables: Cohen (1977) presents power tables for various effect sizes. To use them our researcher needs to calculate the effect size based on related groups using the formula

[3.1.10]
$$f^* = f \frac{\sqrt{n_G}}{\sqrt{1 + (n_G - 1)\rho}} .$$

Here we have that $f = .25$; n_G = number of students per class = 20; and $\rho = .20$, therefore,

$$f^* = .25(\sqrt{20}/\sqrt{1 + (20-1).20})$$

and

$$f^* = .51.$$

Cohen (1977 , p. 311) indicates that power for $f^* = .50$ is .80 when the number of classes is 21 and is .91 when the number of classes is 22. (Note that our f^* is .51 so that we could expect power to be slightly larger than what is found in Cohen's table.)

Example: Tang's Charts: Tang's charts are available in many intermediate level statistics books, e.g. Dixon and Massey (1969, pp. 524-531), Glass and Stanley (1970, pp. 548-551), Johnson and Leone (1977, pp. 1029-1032), and Kirk (1968, pp. 540-547). To calculate power we must find $\emptyset^*$ using formula [3.1.11]

$$\emptyset^* = \sqrt{G}\, f^*$$

where G is the number of classes (groups) per treatment. In the preceding paragraph we found $f^* = .51$ so we can substitute different numbers of classes for G and use Tang's charts to see if we have selected a sample size large enough to have power greater than or equal to .90. For example if we set $G = 16$ then $\phi^* = .51 \cdot 4 = 2.04$. To use Tang's charts we need the degrees of freedom for treatments which is one minus the number of factor levels or in our case $2 - 1 = 1$, and the degrees of freedom for error which is the sum of the number of units in each cell minus the number of cells or here $32 - 2 = 30$. Then power in Kirk (1968, p. 540) is approximately .80; if $G = 25$ then $\phi^* = 2.55$ and power is ($df = 1,48$) approximately .95. Therefore, the researchers would randomly assign 25 classes to each treatment and be relatively sure of detecting treatment differences if they exist.

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1. INTRODUCTION

1.1 Questions and Problems

In educational research and evaluation the mean of a group (e.g. a class of students) frequently is or should be used as the unit of analysis in field experiments. The importance of this point has been stressed by several authors, e.g. Bock & Wiley (1967); Cronback (1976); Glending (1976); Poynor (1974). The purpose of this paper is to aid researchers in designing field experimemts that have enough units (groups) to detect "meaningful differences" among an experiment's treatment levels (e.g. among different methods of teaching arithmetic or reading). Meaningful differences among treatment levels are described in detail in a book by Cohen (1977), but they are basically--expressed quantitatively as differences among the treatment level population means; established beforehand by the experimeter on the basis of theory and/or past experience; estimated by the mean differences among the sample treatment means; and, if found to exist, usually indicate that some action must be taken and/or changes made. Examples are illustrated later in this paper in Section 5. The statistical tool primarily used to establish differences among treatment level means is Fisher's F-test. Therefore, the focus of this paper is on the probability that differences will be found among sample treatment means when, indeed, such differences do exist among the population means. The latter probability is known as the power of the F-test. This focus differs from other discussions of power analysis in that the unit of analysis considered here is the group mean where there is a relationship among the members of the group; such a relationship is typically found in a classroom situation. That is, the basic question answered in this paper is: In an analysis of variance, ANOVA, where the units of analysis are independent group means, found by averaging over related scores, how many such units should be randomly sampled in order to have a high probability of detecting meaningful differences among the treatment level means?

Methodology: A Dilemma

Many field studies in education are nonexperimental because subjects have not been randomly assigned to treatments. This situation creates both internal and external validity problems with regard to determining treatment or program effects. Internal validity may be violated because of the final observed mean differences may not have been caused by the treatments, but could be an artifact of the improper use of the statistical test involved (as we shall see when the violation of the independence assumption is discussed), or the result of the class bully (see the example presented by Peckham, Glass and Hopkins, 1969, pp. 338-341). Without internal validity there can be no external validity, but frequently, even if we could establish internal validity with individual students as units, it would be more appropriate to make generalizations about classes of students. It is often true, however, that very often the group or unit of which a subject is a member is, or can be, assigned to treatments at random. When this is the case a nonexperimental design, where the subject is the unit of analysis, may become an experimental design, where the group mean is the unit of analysis (Bock & Wiley, 1967).

In an experimental design where groups (e.g. classrooms) have been randomly assigned to treatments (levels) many educational research specialists find themselves in the following dilemma: Should each classroom mean serve as the unit of analysis, and have the design suffer a disastrous loss in statistical power, or should each subject serve as the unit of analysis and have the internal validity of the design placed in jeopardy? This point is emphasized when Glass and Stanley (1970) in discussing a specific example concerned with the preceding dilemma comment "He can run a legitimate analysis on the means of five or six classrooms, 'classroom' being the actual experimental unit, in which case he is almost certain to obtain statistically nonsignificant results (with only five or six replications, the power of his significance test is low)" (p. 507). Unfortunately, and, all too often, research specialists select the individual subject as the unit of analysis in order to improve their chances of finding a significant difference among treatment means; jeopardizing the external validity of the study.

The Independence Assumption

The improper choice of the student as the unit of analysis over the proper choice of the classroom or school is unfortunate for two reasons. First, Glass, Peckham and Sanders (1972) have indicated that the single most important assumption made in analysis of variance is independence of the units of analysis. They presented data to support this claim and went on to state: "We present these data first to emphasize that the violation of the independence assumption, which we shall not discuss further in this paper, is far more serious than the violation of assumptions which we will discuss" (p. 242). Second, although power will drop when fewer units of analysis are available, the research literature fails to indicate how much of a loss in power can be expected. Peckham, Glass, and Hopkins (1969, p. 344) present an example to illustrate the generally small loss of statistical power when *independent observations* are grouped and the group mean is the unit of analysis. However, no literature could be found which discussed power calculations when the observations in a group were correlated and group mean was the unit of analysis.

To further dramatize the importance of the assumption of independence of the observations in an analysis of variance Table 1.1.1 was constructed using procedures described by Walsh (1947). In this table it can be seen that the probability of rejecting the null hypotheses of no treatment effects when indeed there are no treatment effects, i.e. of making a type I error, increases dramatically as the relationship among the individuals in a group increases and as the number of subjects per group increases. For example, when the interrelationship among the students in a class is measured at .20 (which as we shall see later is a reasonable value for most classes), and there are 25 students in each treatment, the probability of making a type I error is .46. One statistic most researchers usually point to with pride is the number of students per treatment--in the latter case with 100 students per treatment the probability of making a type I error is .70! With probabilities of making errors being this high researchers cannot afford to continue using dependent and, therefore improper, units of analysis. Instead methodologists should focus there attention on the use of appropriate units of analysis--to date this does not appear to be happening.

Statistical Power

None of the following standard behavioral science statistics texts present an adequate discussion of power when the group mean is used as the unit of analysis: Dayton, 1970; Ferguson, 1966; Glass and Stanley, 1970; Guenther, 1964; Hays, 1963; Kerlinger and Pedhazur, 1973; Kirk, 1968; Lindquist, 1953; Snedecor and Cochran, 1967; Winer, 1971. Many of these authors fail to even discuss the topic of unit of analysis. Further, Peckham, Glass and Hopkins (1969) reference several of these

TABLE 1.1.1: Actual Levels of Significance in an ANOVA with Two Treatments Where the Interrelationship Among the Individuals in a Cell is Measured by the Intraclass Correlation and the Nominal Level of Significance is .05

n per	Intraclass Correlations										
cell	0.00	0.01	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80
10	0.05	0.06	0.11	0.17	0.28	0.37	0.46	0.53	0.61	0.68	0.75
20	0.05	0.07	0.17	0.27	0.41	0.52	0.60	0.66	0.72	0.77	0.82
25	0.05	0.08	0.19	0.31	0.46	0.56	0.63	0.70	0.75	0.80	0.84
30	0.05	0.08	0.22	0.34	0.50	0.59	0.66	0.72	0.77	0.81	0.86
35	0.05	0.09	0.24	0.37	0.52	0.62	0.69	0.74	0.79	0.83	0.87
40	0.05	0.10	0.26	0.40	0.55	0.64	0.71	0.76	0.80	0.84	0.88
50	0.05	0.11	0.30	0.44	0.59	0.68	0.74	0.78	0.82	0.86	0.89
100	0.05	0.17	0.43	0.57	0.70	0.77	0.81	0.84	0.87	0.90	0.92

texts as having improper examples of designs where the individual was treated as the unit of analysis and ". . . where the treatment was clearly administered to groups of individuals" (p. 342).

Peckham, et al. (1969) present an excellent discussion on the experimental unit in statistical analysis. The main focus of their article is on the "dependency-effect" a researcher ignores when the individual is considered as the unit of analysis, and treatment was given to one or more groups of individuals. They indicate that with random assignment of subjects to groups within treatments, dependencies probably exist among the subjects in each of the groups formed. If these dependencies exist, they may be confounded with treatment effects. For example, consider the dependencies formed among the individuals in a group when a bright helping individual and/or a disruptive individual is/are included in the group.

The problem is compounded, however, if intact groups are used in an experiment and the individual is considered as the unit of analysis. Since intact groups usually have some raison d'etre the dependency-effects present in these groups will generally be more pronounced than with groups formed through random assignment of individuals. With their focus on dependency-effects Peckham et al. (1969, p. 344) were able to only briefly discuss statistical power analysis, but they do present an example to illustrate the generally small loss of power when the group mean is the unit of analysis.

To help solve the dilemma presented on the second page of this paper, researchers who analyze field studies data need information on the power (the probability of rejecting the null hypothesis, when indeed the null hypothesis is false) of a statistical test when the observations in a group are correlated and group mean is the unit of analysis. What is not needed are further field study designs (non-experimental) where the individual serves as the unit of analysis and where the dependency assumption of the analysis of variance is violated. Armed with power tables which indicate the power of an F-test in an analysis of variance where group mean is the unit of analysis, the researcher will be able to plan in advance the number of groups necessary for each cell in a design. If a study has been finished without planned power, such power tables would enable the researcher to do a post hoc power analysis. In the latter case if power was found to be insufficient, and the null hypothesis was not rejected, the results should be viewed as inconclusive; thus avoiding possible failure to further investigate a prospective research area. If the null hypothesis was rejected the evidence might indicate a larger or smaller treatment effect than was thought to exist. In all cases such power tables would lead to improved research planning and better research results.

For example, consider the research study completed by Eldridge, Witmer, Barcikowski, and Bauer (1977) where the main research question was: Will the use of the planned program called Developing Understanding of Self and Others (DUSO) with retarded children increase the self concepts of these children? Twenty schools, with one classroom in each school, were randomly assigned to a treatment (work with the DUSO materials) and a non-treatment (no DUSO materials) group. Since subjects were not randomly assigned to treatment the field study was nonexperimental research. However, it became experimental research when each classroom was treated as the unit of analysis, with 10 classrooms in each treatment. In this field experiment the null hypothesis was not rejected. What conclusions could be drawn? The answer is, hardly any. Why? Because the power of the experiment could not be calculated. The researchers did not know if they had enough groups to detect a treatment effect. Even if they could postulate some degree of relationship among the subjects in the classrooms; presently, there are no power tables to indicate the probability they had of rejecting their null hypothesis. In what follows such power tables are constructed.

2. FOUNDATION: ENTITIES AS UNITS

2.1. Terminology

This section was given the preceding title because it contains material that is meant to help understand statistical power and some of the important terms used in this paper when entities are the units of analysis. Readers familiar with power analysis should be able to quickly review this section and go on to the next where groups as units are treated.

Method of Presentation

(Level 1) Taped Lecture	(Level 2) TV Lecture	(Level 3) Live Lecture
Cell 1 30 students	Cell 2 30 students	Cell 3 30 students
Dependent Variable = Mathematics Achievement		

Figure 2.1.1. Design for a One-Way (One Factor) Analysis of Variance

The design illustrated in Figure 2.1.1 serves as a focal point for the development of the ANOVA terminology used here. The question that a researcher is interested in answering with this design is: Does the method of presentation of material on which an exam is based affect the score that one achieves on the exam? In this design the independent variable (factor) is Method of Presentation. The types of method of presentation to be investigated, frequently called levels, factor levels, treatments, or treatment levels, are: Taped Lecture, TV Lecture, and Live Lecture. Each level of the factor identifies one cell in the design to which students, here the units of analysis or observations, are randomly assigned. The letter n refers to the number of students in each cell, i.e. the cell frequency; here there are 30 students in each cell. Throughout this section students, or more generally--entities, will serve as the units of analysis, but to facilitate later discussion the following definitions are made:

Entity - the initial person, place or thing on which a measurement is taken,

Group - a collection of entities,

Unit of Analysis - The entity or group in a statistical design which has been randomly assigned to a treatment level (cell) where the measurement (score) on the entity or group is arrived at independent of the measurement of any other entity or group.[1]

To help answer the question posed by the researcher Fisher's F-test is used to determine if there are statistically significant differences among the treatment level means in Figure 2.1.1. In using the F-test the researcher must worry about the possibility of making one of two types of errors: Type I error which refers to the possibility of detecting a significant difference among the sample means when none actually exists among the corresponding population means, i.e. the possibility of rejecting a true null hypothesis; Type II error which refers to the possibility of finding no differences among the sample means when differences do exist among the population means, i.e. the possibility of failing to reject a false null hypothesis. In most research Type I error is considered to be the most important because if it is made some actions will usually be taken. For example, in the above study if the TV lecture is found to be better than the other two methods of presentation we may find school systems investing hugh sums of money in television sets and in preparing their teachers to perform on TV. To hold down Type I error a researcher makes the probability of making such an error, i.e. the level of significance, low, usually at .05 (1 out of 20) or .01 (1 out of 100).

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[1] Glass and Stanley (1970, pp. 505-506) differentiate between the unit of analysis and the experimental unit. These terms are used synonomously in this paper.

Type II error is not considered as important as Type I error primarily because if it is made no action is usually taken. For this reason most educational researchers still completely ignore the action of protecting themselves against the possibility of making a Type II error. Fisher (1925) himself was not that interested in Type II error (for a discussion of this point see Hogben, 1970) and consequently most statistical texts that followed his either completely ignored the issue or presented power explanations that were abstract and not woven into the planning stages of research design. The result has been conflicting research results and many poorly planned research studies. For, by ignoring the probability of making a Type II error, a researcher may find significant but meaningless results or may completely overlook a significant area of research. As we shall see shortly, the probability of making a Type II error is directly tied to the sample size that one selects; if the sample is too large statistical significance may be found, i.e. the population means do differ, but not enough to cause actions to be taken, and if sample size is too small, no statistically significant differences may be found when they do exist to an important degree among the population means.

More recently, a few researchers and textbook writers have become accutely aware of this problem and more research studies and textbooks are adequately treating Type II error. One result has been that Cohen (1977, p. 56) has suggested that as a good rule of thumb the probability of making a Type II error should be set at .80. That is a researcher should select a sample size that will allow him to detect meaningful mean differences, at least 80% of the time. This standard indicates the importance of Type I error compared to Type II error because the probability of making a Type II error here is .20 as compared to .05 or .01 for Type I error, but .80 serves as a good bench mark and it should probably be considered as the minimum value for most experimental studies.

2.2. Power Calculations: Two Methods

There are two common ways that researchers can find power when entities are used as the units of analysis. They are through use of power curves compiled by Tang (1938) which are found in many statistics books (e.g. Keppel, 1973; Kirk, 1968; Winer, 1971) or through tables provided by Cohen (1977). Both of these methods are reviewed in the following two subsections.

Tang's Charts

The initial presentation in this part is based on a discussion in Kirk (1968, pp. 107-110).

Define a treatment effect β_j to represent the difference $\mu_j - \mu$ between the treatment population mean and the grand population mean for $j = 1,\ldots,J$ treatment levels, then let B_j represent the effect of treatment j in an experiment, where the null hypothesis to be tested is:

H_0: $B_j = 0$ for all j.

If H_0 is false, i.e. $B_j \neq 0$ for all j, then the ratio of the mean square between groups, MS_{WG}, to the mean square within groups, MS_{BG}, has a distribution known as the noncentral F. This distribution depends on three parameters, γ_1, the degrees of freedom associated with MS_{BG}, γ_2, the degrees of freedom associated with MS_{WG}, and a noncentrality parameter, δ, where

$$\delta = \sqrt{\sum_{j=1}^{J} n\, B_j^2/\sigma_e^2} \qquad (2.2.1)$$

with, n, the number of units of analysis (i.e. sample size), J, the number of treatments, and, σ_e^2, the error variance. Tang (1938) prepared charts which enable one to calculate power using a function of δ,

$$\emptyset = \sqrt{\sum_{j=1}^{J} B_j^2/J} \Big/ \sigma_e/\sqrt{n}. \qquad (2.2.2)$$

The usual procedure for calculating statistical power is to find an estimate, $\hat{\sigma}_e$, of σ_e based on previous research (e.g., a pilot study) and to determine $\sum_{j=1}^{J} B_j^2$ from theory or based on some rationale. Various sample sizes are then introduced into the equation for $\emptyset$ and Tang's charts are consulted at a given level of significance (α) for the power associated with each n. In lieu of previous research, many social scientists select differences among the treatment effects in terms of σ_e. The usual procedure using this approach is to set $\sum_{j=1}^{J} B_j^2$ at its minimum which can be shown to be $c^2\sigma_e^2/2$, where c is any number greater than zero. The researcher can then be certain that if a difference as large as $c\sigma_e$ occurs in his data the actual power will be at least as large as that found using the minimum value.

Substitution of $c^2\sigma_e^2/2$ for $\sum_{j=1}^{J} B_j^2$ in (2.2.2) yields $\emptyset = \sqrt{n}\,\sqrt{c^2/2J}$. A researcher can then select a value for c and J substitute different values for n, and use Tang's charts to find a desirable power.

Cohen's Tables

Cohen (1962, 1965, 1969, 1970, 1973) has written widely on the topic of statistical power analysis and his text (Cohen, 1969; revised in 1977) provides social scientists with many excellent examples and rules to follow when calculating power in a variety of research designs. Since many researchers have used Cohen's procedure (Barcikowski, 1973; Brewer, 1972; Brewer and Owen, 1973; Galdieri, Barcikowski, and Witmer, 1972; Haase, 1974; Jones and Brewer, 1972; Penick and Brewer, 1972; Tversky and Daniel, 1971) it is presented here and related to the use of ϕ.

Cohen does not use ϕ directly to calculate power. Instead he presents a rationale for use of an index he calls "effect size". Cohen (1969) describes the term as follows: "Without intending any necessary implication of causality, it is convenient to use the phrase 'effect size' to mean 'the degree to which the phenomenon is present in the population' or 'the degree to which the null hypothesis is false'" (pp. 9-10). The formula[1] for calculating effect size, f, for tests on means in analysis of variance and covariance is

$$f = \sigma_\mu / \sigma_e \qquad (2.2.3)$$

where

$$\sigma_\mu = \sum_{j=1}^{J} (\mu_j - \mu)^2 / J \qquad (2.2.4)$$

and μ_j is the population mean of cell j and μ is the combined mean of the μ_j's. The formulas assume an equal number of observations in each cell. Cohen (1969, pp. 352-355) provides a discussion of f for unequal n.

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[1] The formulas found here were taken from Cohen (1969, pp. 267-268) and modified to coincide with the notation used in this paper.

The relationship between ϕ and f is given by

$$f = \phi/\sqrt{n} \qquad (2.2.5)$$

or

$$\phi = f\sqrt{n}. \qquad (2.2.6)$$

Cohen describes three different effect sizes, 'small', f = .10, 'medium,' f = .25, and 'large,' f = .40 that can be used as guides in lieu of previous research to represent the treatment differences among the populations represented in each treatment level. He describes small effect sizes as those likely to be found in new research. "This is because the phenomena under study are typically not under good experimental or measurement control or both" (p. 23). He indicates, however, that small effect size "is the order of magnitude of the difference in mean IQ between twins and nontwins, the latter being larger (Husen, 1959)" (p. 24). A medium effect size is one that is visible to the naked eye such as the difference in intelligence between clerical and semiskilled workers. A large effect size is represented by the mean IQ difference estimated between holders of the Ph.D. degree and typical college freshmen, or between college graduates and persons with only a 50-50 chance of passing in an academic high school curriculum (Cronbach, 1960, p. 174)" (p. 25).

3. FOUNDATION: GROUPS AS UNITS

3.1. Group Power Calculations: Two Methods

In this section the calculation of power when group mean is the unit of analysis is described. This is done by first describing the difference in calculating error variance when entities and when groups are the units of analysis, and then considering Tang's ϕ and Cohen's ES when groups are the units of analysis and there is a relationship between the members of each group. The section ends with a discussion of the use of the intraclass correlation as a measure of relationship among the members in a group.

In section 2.2 two methods were illustrated which enable a researcher to calculate power when entities are the units of analysis. When we consider the design illustrated in 2.1 (Figure 2.1.1) we find 30 students (entities) in each cell. In section 1.1 we noted that the most important assumption is analysis of variance was that the entities in each cell must be independent of one another and we saw the disastrous affects on Type I error if we violated this assumption. Now, if the method of presentation design from section 2.1 was studied in a field setting, i.e. in a school, it would be very unlikely that the 30 students would function independent of one another. Instead there would probably be one, two,or three classes within each treatment level. Let us assume that there are three classes in each treatment level and that the classes are independent of each other. Then, we would have three groups, units of analysis, in each level with ten entities in each group. If we wanted to compute the power in this design it would seem that we could take formula 2.2.2 or 2.2.3, replace $\underline{n}$, the number of entities, with G, the number of groups, and calculate the power as before. The problem with this reasoning is that the error variance, σ_e, found in these formulas, and therefore the charts and tables derived from them, is based on independent measures of entities not on group means where there are correlations among the members of the group. In the next subsection the standard error of the mean for units based on such group means is derived.

Group Mean Error Variance

In this presentation it is assumed that there are an equal number of entities per group and an equal number of groups per cell in a one-way analysis of variance design.

Consider the scores of entities in a group, they may be considered to have come from a multivariate normal distribution with mean vector $\underline{\mu}$ and variance covariance matrix Σ. That is if $\underline{x}$ is the vector of scores in a group, then $\underline{x} \sim$ Mult. N $(\underline{\mu}, \Sigma)$. Then it can be shown (Tatsuoka, 1971, pp. 95-124) that $\bar{y}$ found by performing the transformation $v'\underline{x} = \bar{y}$ is normally distributed with mean $v'\underline{\mu}$ and variance $v'\Sigma v$. In this case if we let $v' = (\frac{1}{n_G} \; \frac{1}{n_G} \ldots \frac{1}{n_G})$, n_G = the number of entities in a group, then $\bar{y}$ is the group mean.

Example: Let us consider an example where we have three entities in a group and the correlation, ρ, among them is zero. Then,

$$\begin{bmatrix} x_1 \\ x_2 \\ x_2 \end{bmatrix} \sim \text{Mult. Normal} \left(\begin{bmatrix} \mu \\ \mu \\ \mu \end{bmatrix}, \begin{bmatrix} \sigma_e^2 & 0 & 0 \\ 0 & \sigma_e^2 & 0 \\ 0 & 0 & \sigma_e^2 \end{bmatrix} \right).$$

Now, if $v' = [1/3 \;\; 1/3 \;\; 1/3]$, we have that

$$[1/3 \;\; 1/3 \;\; 1/3] \cdot \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \bar{y}, \text{ and } \bar{y} \sim \text{Normal } (\mu, \sigma_e^2/3) \text{ because}$$

$$[1/3 \quad 1/3 \quad 1/3] \begin{bmatrix} \mu \\ \mu \\ \mu \end{bmatrix} = \mu/3 + \mu/3 + \mu/3 = 3\mu/3 = \mu$$

and

$$[1/3 \quad 1/3 \quad 1/3] \begin{bmatrix} \sigma_e^2 & 0 & 0 \\ 0 & \sigma_e^2 & 0 \\ 0 & 0 & \sigma_e^2 \end{bmatrix} \begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix} =$$

$$[\sigma_e^2/3 \quad \sigma_e^2/3 \quad \sigma_e^2/3] \begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix} = \sigma_e^2/9 + \sigma_e^2/9 + \sigma_e^2/9 = 3\sigma_e^2/9 = \sigma_e^2/3.$$

The fact that $\overline{y}$ comes from a normal distribution with mean μ and variance $\sigma_e^2/3$ is a result of the central limit theorem which states that the mean of n_G independent observations comes from a normal distribution whose mean is the mean of the original distribution of scores and whose variance is σ_e^2/n_G.

Now, when a group's mean is used as the unit of analysis the variance of the distribution from which the mean was taken is $v' \Sigma v$ or because in this case $v' = 1/n_G \mathbf{1}'$, where $\mathbf{1}$ is a vector of ones, $v' \Sigma v = 1/n_G \mathbf{1}' \Sigma \mathbf{1} \, 1/n_G$. The latter product is equal to $1/n_G^2 \mathbf{1}' \Sigma \mathbf{1}$, because $1/n_G$ is a constant; here, $\mathbf{1}' \Sigma \mathbf{1}$ is the sum of all of the elements in Σ. Because a group contains n_G entities, the sum of the elements in Σ will contain $n_G \sigma_e^2$'s and $(n_G^2 - n_G)\rho\sigma_e^2$'s--if we assume that the relationship among all of the subjects is constant, i.e. equal to ρ. Therefore, the variance of the resulting group means, $\overline{y}$'s, is

$$\sigma_{e_G}^2 = 1/n_G^2(n_G\sigma_e^2 + (n_G^2 - n_G)\rho\sigma_e^2) \qquad [3.1.1]$$

which is equal to

$$\sigma_{e_G}^2 = (\sigma_e^2/n_G)(1 + (n_G-1)\rho) \qquad [3.1.2]$$

and the standard deviation, i.e., the standard deviation of group means where the relationship among the entities in the group is ρ, is

$$\sigma_{e_G} = (\sigma_e/\sqrt{n_G})\sqrt{(1 + (n_G-1)\rho)}. \qquad [3.1.3]$$

This formula was initially derived by Harris (1913). It is used next to derive Tang's ϕ and Cohen's f when groups are the units of analysis.

Tang's Charts

Let ϕ^* be Tang's ϕ when group mean is the unit of analysis. Then, substituting [3.1.3] into (2.2.2) we have

$$\phi^* = \sqrt{\sum_{j=1}^{J} B_j^2/J} \Big/ \sigma_{e_G}/\sqrt{G} \qquad [3.1.4]$$

where G is the number of groups.

Now [3.1.4] can be written as

$$\phi^* = \sqrt{G}\sqrt{\sum_{j=1}^{J} B_j^2/J} \Big/ \sigma_e\sqrt{1 + (n_G)\rho}/\sqrt{n_G}, \qquad [3.1.5]$$

but since $\sqrt{G}\cdot\sqrt{n_G} = \sqrt{n}$ the number of entities in a cell, we have that

$$\phi^* = \frac{\sqrt{n}\sqrt{\sum_{j=1}^{J} B_j^2/J}}{\sigma_e\sqrt{1 + (n_G-1)\rho}}. \qquad [3.1.6]$$

Therefore, substituting (2.2.2) into [3.1.6] we have that the relationship between ϕ^* and ϕ is given by

$$\phi^* = \phi/\sqrt{1 + (n_G-1)\rho}. \qquad [3.1.7]$$

Cohen's Effect Size

Let f* represent Cohen's effect size when group mean is the unit of analysis. Then, substituting [3.1.3] into [2.2.3] we have

$$f^* = \sigma_\mu/\sigma_{e_G} \qquad [3.1.8]$$

or

$$f^* = \sqrt{n_G}\,\sigma_\mu/\sigma_e\sqrt{(1 + (n_G-1)\rho)}. \qquad [3.1.9]$$

Rewriting f^* in terms of f by substituting (2.2.3) in [3.1.9] we have

$$f^* = f\left(\frac{\sqrt{n_G}}{\sqrt{(1 + (n_G-1)\rho}}\right) \qquad [3.1.10]$$

A comparison of $\emptyset^*$, $\emptyset$, f and f^*

It is interesting to note that when $\rho > 0$ we have that $f^* > f$, but that $\emptyset^* < \emptyset$. For example, when $f = .25$ and group mean is the unit of analysis with 25 entities per group and $\rho = .10$, from [3.1.10] $f^* = .68$. In this same example, if there were four groups we have that $\emptyset = 2.5$ from (2.2.6) and $\emptyset^* = 1.36$ from [3.1.7]. This is important to note because many researchers might feel that f and $\emptyset$ do not change when groups are considered, but as can be seen they certainly do. Also using [3.1.4] we have that the relationship between f^* and $\emptyset^*$ is

$$\emptyset^* = \sqrt{G}\, f^* \qquad [3.1.11]$$

and

$$f^* = \emptyset^*/\sqrt{G} \qquad [3.1.12]$$

Importantly, however, armed with formulas [3.1.6] and [3.1.9] researchers may now use Tang's Charts or Cohen's Tables to calculate power when groups are the units of analysis and there is an interrelationship, ρ, among the members of the group. The main problem still to be considered is how to estimate ρ; this problem is considered next.

3.2. Estimation of the Interrelationship Among Entities in a Group

Much of the history and formulas described here were taken from Haggard (1958, pp. 1-34). In the preceding two subsections it was assumed that the relationship among entities in a group was measured by the correlation between every pair of members in the group, and that this correlation, ρ, was constant among all pairs. The general problem that is considered here is: When there are several groups of entities, e.g. classes of subjects, how can the interrelationship among the subjects be measured? Interestingly, Pearson (1901) suggested a solution to this problem when he considered the problem of estimating fraternal resemblance, i.e. the correlation between the heights of brothers. In the latter case the group is a family and the entities are brothers. Pearson suggested computation of the product moment correlation between all possible pairs in a group and then using the average correlation across pairs and groups to represent the relationship sought. Harris (1913) developed a method which arrived at this average correlation much faster than the method of averaging over symmetric correlation matrices suggested by Pearson. The method suggested by Harris involves considering the groups as treatments in a one-way ANOVA and then calculating a measure of relationship denoted by Haggard (1958, p. 11) as R_H, where

$$R_H = \frac{MSB^* - MSW}{MSB^* + (n_G - 1)MSW}, \qquad [3.2.1]$$

In [3.2.1] MSB* = the sum of squares between groups divided by the number of groups, MSW = within groups mean square, and n_G is the number of entities per group (treatment). When we have an infinite population it can be shown that $R_H = \rho$ (Jessen, 1978, pp. 88-91) or as we shall see next $\bar{\rho}$.

In [3.1.1] we have the variance of the resulting group mean; the part of this equation in parentheses is the sum of the elements of the variance-covariance matrix, Σ. Here the term $(n_G^2 - n_G)\rho\sigma_e^2$ is the sum of all the covariance terms and it assumes equal variances and correlations between entities. If we keep the assumption of equal variances but consider unequal correlations this term would look like $\sum_{i=1}^{n_G^2-n_G}\rho_i\sigma_e^2$, which is equal to $(n_G^2-n_G)\bar{\rho}\sigma_e^2$, because $\sum_{i=1}^{n_G^2-n_G}\rho_i/(n_G^2-n_G) = \bar{\rho}$. Therefore, when the relationships vary among the entities in a group, we have that the variance of such group means is

$$\sigma_{e_G}^2 = \frac{1}{n_G^2}(n_G\sigma_e^2 + (n_G^2 - n_G)\bar{\rho}\sigma_e^2). \qquad [3.2.2]$$

Now, if we use R_H from [3.2.1] to estimate $\bar{\rho}$; MST to estimate σ_e^2; and substitute in [3.2.2] to estimate $\sigma_{e_G}^2$, then these values may be used with [3.1.6] or [3.1.9] to estimate power when group mean is the unit of analysis and there are interrelationships among the entities in the groups. However, as we shall see in section 5, this would be an unreasonable approach because if we had subjects as groups we could calculate $\sigma_{e_G}^2$ directly from the group mean and would not have to estimate $\bar{\rho}$. Instead the value of the relationship shown in [3.2.2] is that it will enable us to calculate power based on previously estimated values of $\bar{\rho}$; with treatment effects based on entities. This approach will be discussed in more detail using examples in Section 5. We next consider other estimates of $\bar{\rho}$ or ρ, and because ρ or $\bar{\rho}$ may be used interchangably in [3.2.2] we will only discuss estimates of ρ; $\bar{\rho}$ will be understood to be interchangable.

Other Estimates of ρ

Haggard (1958, p. 12) indicates that Harris's R_H, [3.2.1], is a biased estimate of a measure of interrelationship among entities in a group called the intraclass correlation coefficient, which he denotes by R. This is the reason that Haggard placed an asterick on BCMS in [3.2.1]. Here the estimate of between group variance was divided by the number of groups; for BCMS to be an unbiased estimate of between group variance it should be divided by the number of groups minus one. Haggard attributes this refinement to Fisher (1950), with the resultant formula being written

$$R = \frac{MSB - MSW}{MSB + (n_G - 1)MSW} . \qquad [3.2.3]$$

Haggard (p. 6) describes this intraclass correlation as "the measure of the relative homogeneity of scores within classes in relation to the total variation among all the scores in the table." He goes on to indicate that R is a more appropriate and in certain respects a more general measure than ρ. This is because R is a univariate statistic while ρ is a bivariate statistic. That is to calculate ρ, an x and y must be specified, but R may be calculated when two or more scores are involved with no specification of order.

Winer (1971, p. 248) indicates that [3.2.3], although made up of unbiased estimates of error variances, is itself biased. This is because it is frequently true that although one has unbiased estimates of two variances it does not mean that their ratio is unbiased (Olkin and Pratt, 1958). What Winer reports is an unbiased estimate of $\theta = \sigma_T^2/\sigma_e^2$, where σ_T^2 = variance between treatments (here groups) and σ_e^2 = variance within treatments. The unbiased estimate of θ is

$$\hat{\theta} = \frac{MSB - m\ MSW}{n_G\ m\ MSW} \qquad [3.2.4]$$

where

$$m = \frac{G(n - 1)}{G(n - 1) - 2} .$$

Using $\hat{\theta}$ to estimate R, Winer (p. 249) gives

$$\hat{R} = \frac{\hat{\theta}}{1 + \hat{\theta}} . \qquad [3.2.5]$$

Unequal number of entities per group

When an unequal number of entities are present per group formula [3.2.3] becomes

$$R = \frac{MSB - MSW}{MSB + (\bar{n}_G - 1)MSW}, \qquad [3.2.6]$$

where

$$\bar{n}_G = \frac{1}{G-1}\left(\Sigma n_g - \frac{\Sigma n_g^2}{\Sigma n_g}\right),$$

with G = number of groups with n_g entities per group.

Confidence interval on R. A (1-2α) confidence interval may established for R using:

$$\text{Upper confidence limit} = R_u = \frac{F_u - 1}{F_u + (n_G - 1)} \qquad [3.2.7]$$

and

$$\text{Lower confidence limit} = R_L = \frac{F_L - 1}{F_L + (n_G - 1)} \qquad [3.2.8]$$

where $F_u = F_0 \times F_\alpha$; and $F_L = F_0/F_\alpha$; F_0 = the observed F value; and F_α = the table F value with level of significance equal to α. When an unequal number of entities are found per group $\bar{n}_G$ replaces n_G in [3.2.7] and [3.2.8].

Conclusion

At this point it is unclear which of the formulas [3.2.1], [3.2.3] or [3.2.5] should be used to estimate ρ in [3.1.6] or [3.1.9] to calculate power values. However, with a large number of groups these formulas will yield values that are fairly close to one another and since [3.2.3] is found in many statistics texts, and because Haggard has provided a good deal of information on it, [3.2.3] will be used in the rest of this paper to estimate ρ in formula [3.1.1].

3.3 Estimates of Interrelationship: Examples

Equations [3.1.7] and [3.1.10] would enable educational researchers to quickly calculate power, and therefore sample size, if a reasonable value for ρ was known. With this in mind, data on groups (classes and schools) from a variety of sources and over several variables was found which enabled estimates of ρ to be calculated primarily using Haggard's R in [3.2.6]. Ideally, if the ρ estimates were found to be stable over variables and conditions, a standard value for ρ could be substituted into the latter power equations as a measure of interrelationship found in particular types of classes. Fortunately this seems to be the case as is illustrated in the following examples where ρ is estimated.

Example 1: Classes in One School

In Tables 3.3.1 and 3.3.2 there are estimates of the intraclass correlation coefficient found using the formulas described by Harris (3.2.1), Haggard (3.2.3) and Winer (3.2.5) along with the confidence limits (3.2.7) and (3.2.8) for the Haggard R. The estimates are based on scores from subtests of the Iowa Test of Basic Skills which were administered to fifth and sixth grade classes in a school from a small city in Ohio. All fifth and sixth grade students in this city are sent to this school. There were eleven fifth grades and nine sixth grades with the class sizes ranging from fourteen to twenty-nine. The school principal indicated that the fifth grade classes were formed so that the students were placed in classes where they were able to "get along" with the other students; there was a reasonable academic balance, i.e. heterrogeneous academic grouping; and where it was felt that the class climate of either a structured or unstructured setting would facilitate their learning. On the other hand, the sixth grade classes were formed primarily on the basis of the students' ability. Within Tables 3.1.1 and 3.1.2 the estimates of ρ provided by the three authors do not vary greatly across authors because the number of classes involved was fairly large. Interestingly, the estimates don't vary much across variables, either. However, they do vary strongly between the grades which reflects the manner in which the classes were grouped. The fifth grades had heterrogeneous academic grouping within classes; this would yield homogeneous class means and low estimates of ρ. The sixth grades had homogeneous academic groups within classes; this would yield heterrogeneous class means and high estimates of ρ.

These two sets of classes serve as interesting examples because we can consider them to represent samples from two different types of populations. We might then consider what problems an experimenter would encounter if he had sampled from one of these populations and had randomly assigned similar classes to the treatment levels in the design of Figure 2.1.1, and had used the estimates of ρ found here to calculate the power of his statistical test using (3.1.9). If he based his calculation of ρ on classes like those in the sixth grade his estimate of the relationship among the scores in a class caused by the students being in the same class would be too high. This is because the value of ρ estimated from the sixth grades is not only measuring the relationship caused by students functioning as a class but it also is measuring the relationship caused by class grouping. In this case an analysis of covariance might be performed with academic ability as the covariate and ρ would be estimated from the adjusted scores (see Example 5, Section 5.6). The scores from the fifth grades probably more adequately reflect the value of ρ which is based solely on class interrelationships because these classes were based on

TABLE 3.3.1: Intraclass Correlation Estimates of the Interrelationship, ρ, Among Fifth Grade Students Within Eleven Classes in One School, as Measured Across Twelve Variables

Variable	Intraclass Correlation Estimates			95% Confidence Limits with Haggard's R	
	Harris	Winer	Haggard	Upper	Lower
Word Knowledge	.1473	.1615	.1631	.3171	.0628
Reading	.1839	.1999	.2017	.3694	.0864
Total Reading	.1700	.1854	.1871	.3503	.0772
Language	.1650	.1802	.1819	.3438	.0735
Spelling	.1593	.1741	.1758	.3346	.0705
Math Computation	.1244	.1373	.1387	.2817	.0488
Math Concepts	.1353	.1488	.1504	.2997	.0548
Math Prob Solv	.1164	.1289	.1302	.2597	.0436
Total Math	.1188	.1314	.1328	.2737	.0450
Science	.1548	.1694	.1711	.3285	.0673
Social Studies	.1590	.1739	.1756	.3353	.0696

TABLE 3.3.2: Intraclass Correlation Estimates of the Interrelationship, ρ, Among Sixth Grade Students Within Nine Classes in One School, As Measured Across Ten Variables

Variable	Intraclass Correlation Estimates			95% Confidence Limits with Haggard's R	
	Harris	Winer	Haggard	Upper	Lower
Word Knowledge	.5851	.6116	.6142	.7849	.4049
Reading	.6339	.6591	.6614	.8171	.4567
Total Reading	.6469	.6715	.6739	.8252	.4710
Language	.7590	.7783	.7802	.8898	.6072
Spelling	.8194	.8387	.8455	.9406	.6474
Math Comprehension	.4821	.5101	.5129	.7088	.3061
Math Concepts	.5784	.6051	.6077	.7805	.3978
Math Prob Solv	.5694	.5963	.5989	.7742	.3888
Total Math	.6254	.6508	.6533	.8118	.4472
Science	.2315	.2753	.2835	.5723	.0749

heterogeneous grouping. However, these estimates of ρ are probably still slightly high because the classes did have some criteria for grouping. Only in the case of random assignment to classes would all variables be controlled so that the estimate of ρ found would only represent the classroom interrelationships.

The stability of the intraclass correlation coefficient over variables is an indication that the interrelationship among the students across classes is stable across variables. It seems reasonable that if such a relationship exists, then it would be relatively stable across variables unless there was a interaction between a variable and class interrelationships. The 95% condifence intervals over the variables indicate a range of approximately .05 to .30. As was indicated earlier because the students were assigned to classes based on three criteria this interval probably contains slightly high limits.

Example 2: Classes In One City. Another estimate of ρ based on ten ninth grade Nigerian general science classes, where the students had been assigned to classes with no special criteria, yielded an R of .11 with a 95% confidence interval of .06 to .17. There were about 30 students per class in a city in Nigeria and the estimates were based on scores from a general science examination.

Example 3: Schools In One State. Two other estimates of ρ were obtained for ninth grade students from data in Lindquist (1940, p. 23 and p. 67). The first estimate of ρ was .17; it was based on 24 of the largest schools in Iowa that took the Iowa Every-Pupil-Test in English Correctness in 1935. The second estimate of ρ was also .17; it was based on the same test given in 11 high schools in 1938.

Conclusion

These consistent estimates of ρ in a variety of conditions and over several different variables indicates that a value of $\rho = .20$ might be used as a standard by educational researchers to estimate ρ in formulas (3.1.6) or (3.1.9) for power calculations in the case where students are assigned to groups based on no strong criteria. This idea is explored in more depth in the examples of section 5--especially example [illegible].

3.4. The Group Formulas: An Illustrated Example

The formulas that were just developed for groups are illustrated here using a small contrived example data set. Many of the formulas used with this example are based on population values, so the reader should be aware of the fact that population formulas, especially for variances, are often used here instead of the sample estimates. The main reason for this example is to provide the reader with insight into the formulas and procedures that were developed in this section.

In this example we consider the design in Figure 2.1.1 with only two levels of presentation--Taped Lecture and TV Lecture. There are four groups that receive the taped lecture and four groups that receive the TV lecture. Each intact group is composed of four students and each group was randomly sampled from a population of such groups and randomly assigned to the treatment levels. The design and the data we illustrated in Figure 3.4.1.

As we shall see in the example of the formulas work very nicely because the data was created so that each observation that receives the taped lecture was simply incremented by four in the TV Lecture.

Method of Presentation

Taped Lecture	TV Lecture
0 1 2 [a]	4 5 6
2 3 4	6 7 8
2 3 7	6 7 11
7 8 9	11 12 13
$\bar{X}_1 = 4$	$\bar{X}_2 = 8$

Figure 3.4.1: Design and Contrived Group Data

[a] The scores for each intact group are circled.

For example in the taped lecture for the score of 0 a score of 0 + 4 = 4 is found in the TV lecture. Therefore the treatment means differ by four points.

We now proceed to calculate the intraclass correlation coefficient, R, using two approaches: first, we calculate R using the mean squares and arrive at the estimates suggested by Harris, Haggard, and Winer; then, we shall find R using the method of intercorrelations suggested by Pearson.

Mean square estimate of ρ. To estimate the intraclass correlation using mean squares we must treat each cell in the design of Figure 3.4.1 as a one-way ANOVA with the groups considered as treatments. This is done in Tables 3.4.1 and 3.4.2 along with the ANOVA calculations. As can be seen, because of the method of creating the data, the mean squares are equal in each group. The calculation of the intraclass correlations for both treatments using Harris's formula [3.2.1] is

TABLE 3.4.1: ANOVA on the Intact Groups of Treatment 1

	Groups				
	1	2	3	4	
	0	2	2	7	Y_{ij} = observation i in group j (i=1,2,3; j=1,2,3,4)
	1	3	3	8	$n_j = 3 = n_G$
	2	4	7	9	N = 12 J = 4
Group Total	3	9	12	24	Grand Total = 48
Group Mean(M_j)	1	3	4	8	Grand Mean(M) = 4

Computations--Formulas from Hays (1963, pp. 370-371)

$$\sum_j \sum_i Y_{ij}^2 = 0^2 + 1^2 + \ldots + 9^2 = 290$$

$$(\sum_j \sum_i Y_{ij})^2 = (0 + 1 + \ldots + 9)^2 = (48)^2 = 2304$$

$$\sum_j \frac{1}{n_j}(\sum_i Y_{ij})^2 = 1/3(3^2 + 9^2 + 12^2 + 24^2) = 270 \; [n_j = 3 \text{ for all groups}]$$

$$SST = \sum_j \sum_i (Y_{ij} - M)^2 = \sum_j \sum_i Y_{ij}^2 - \frac{(\sum_j \sum_i Y_{ij})^2}{N} = 290 - 2304/12 = 98$$

$$SSW = \sum_j \sum_i (Y_{ij} - M_j)^2 = \sum_j \sum_i Y_{ij}^2 - \sum_j \frac{(\sum_i Y_{ij})^2}{n_j} = 290 - 270 = 20$$

$$SSB = \sum_j n_j(M_j - M)^2 = \sum_j \frac{1}{n_j}(\sum_i Y_{ij})^2 - \frac{(\sum_j \sum_i Y_{ij})^2}{N} = 270 - 192 = 78$$

$$MST = \sum_j \sum_i (Y_{ij} - M)^2/(N-1) = 98/11$$

$$MSW = \sum_j \sum_i (Y_{ij} - M_j)^2/(n_j(J-1)) = 20/8$$

$$MSB = \sum_j n_j(M_j - M)^2/(J-1) = 78/3 = 26$$

$$MSB^* = \sum_j n_j(M_j - M)^2/J = 78/4$$

TABLE 3.4.2: ANOVA on the Intact Groups of Treatment 2

	Groups				
	1	2	3	4	
	4	6	6	11	
	5	7	7	12	
	6	8	11	13	
Group Total	15	21	24	36	Grand Total = 96
Group Mean	5	7	8	12	Grand Mean = 8

Computations--Formulas are shown in Table 3.4.1

$SST = 866 - 9216/12 = 768/12 = 98$

$SSW = 866 - 846 = 20$

$SSB = 846 - 768 = 78$

$MST = 98/11$

$MSW = 20/8$

$MSB = 78/3 = 26$

$$R_H = \frac{MSB^* - MSW}{MSB^* + (n_G - 1)MSW} = \frac{78/4 - 20/8}{78/4 + (2)(20/8)} =$$

$$R_H = \frac{156/8 - 20/8}{156/8 + 40/8} = \frac{136/\cancel{8}}{196/\cancel{8}} = 136/196 = .6939$$

The calculation of R for both treatments using Haggard's formula [3.2.3] is

$$R = \frac{MSB - MSW}{MSB - (n_G - 1)MSW} = \frac{78/3 - 20/8}{78/3 + (2)(20/8)} =$$

$$R = \frac{624/24 - 60/24}{624/24 + 120/24} = \frac{564/\cancel{24}}{744/\cancel{24}} = .7581$$

The calculation of R for both treatments using Winer's formulas [3.2.4] and [3.2.5] is

$$m = \frac{k(n_g-1)}{k(n_g-1) - 2} = \frac{4(2)}{4(2) - 2} = 8/6 = 4/3$$

$$\hat{\theta} = \frac{MSB - m\ MSW}{n_G\ m\ MSW} = \frac{78/3 - (4/3)(20/8)}{3(4/3)(20/8)} =$$

$$\hat{\theta} = \frac{624/24 - 80/24}{80/24} = \frac{544/\cancel{24}}{80/\cancel{24}} = 6.8$$

$$\hat{R} = \hat{\theta}/(1 + \hat{\theta}) = 6.8/(1+6.8) = 6.8/7.8 = .8718$$

The Haggard and Winer formulas are meant to be used to estimate the population intraclass correlation based on sample observations. In the next discussion we will show that Harris' value for R is appropriate when one is dealing with a population.

Pearson's Average Correlation Estimate of ρ. The population correlation, ρ_{XY}, between two variables X and Y may be written as

$$\rho = \frac{\text{covariance } (X,Y)}{\sigma_X \sigma_Y}$$

where σ_X and σ_Y are the population standard deviations of variables X and Y. Here,

$$\text{covariance } (X,Y) = \frac{\sum_i (X_i-\mu_X)(Y_i-\mu_Y)}{N};$$

N equals the number of observations in the population and μ_X and μ_Y are the population means of the variables X and Y.

In our example we begin to calculate the intercorrelations among the observations in the taped lecture by first considering two things: 1) in this situation there is no way to determine which values should be X's and which Y's (see Haggard, 1958, pp. 8-9 for a further discussion of this point); 2) the mean of the elements in the population is equal to the population mean of the group means. Therefore, instead of X and Y we have X_i and $X_{i'}$, which come from the same population with common mean, μ, and standard deviation σ. Now, the covariance formula can be written as

$$\text{covariance }(X_i, X_{i'}) = \frac{\sum_{i>i'} (X_i-\mu)(X_{i'}-\mu)}{N} .$$

Then, if N = 3, and since $\sigma_X = \sigma_Y$, we have that

$$3\rho\sigma^2 = \sum_{i>i'} (X_i - \mu)(X_{i'} - \mu),$$

and if this is done in each of our 4 groups we have

$$12\rho\sigma^2 = \sum_{j=1}^{4} \sum_{i>i'}^{3} (X_{ij} - \mu)(X_{i'j} - \mu).$$

The data for the taped lecture with the mean of this treatment subtracted from each score is

	$(X_{ij} - \mu_1)$		
Group 1	-4	-3	-2
Group 2	-2	-1	0
Group 3	-2	-1	3
Group 4	3	4	5

The cross products of these difference scores are

	1 x 2	1 x 3	2 x 3	Total
	12	8	6	26
	2	0	0	2
	2	-6	-3	-7
	12	15	20	47
Total	28	17	23	68 = $\sum_{j}^{4} \sum_{i<i'}^{3} (X_{ij}-M_1)(X_{i'j}-M_1)$

Therefore we have that

$$12\rho\sigma^2 = 68.$$

Now if we use the formula

$$\sigma^2 = \sum(X - \mu)^2/N = 98/12$$

we have that

$$\cancel{12}\rho(98/\cancel{12}) = 68$$

$$\rho = 68/98 = .6939$$

This is the same value that we arrived at using Harris' R_H. However, it should be noted that the formulas used assumed that we were dealing with a population, and that these same formulas will yield a biased estimate of ρ when used with a sample.

Effect Size Estimated for Entities. If we consider the entities in Figure 3.4.1 as being independent of one another then we can use (2.2.3) and (2.2.4) to estimate Cohen's effect size as

$$f = \sigma_\mu/\sigma_e \text{ where}$$

$$\sigma_\mu = \sum_{j=1}^{2} (\mu_j - \mu)^2/2 = \sqrt{[(4-6)^2 + (8-6)^2]/2} = 2$$

Method of Presentation

Taped Lecture	TV Lecture
1	5
3	7
4	8
8	12
$\overline{X}_1 = 4$	$\overline{X}_2 = 8$

Figure 3.4.2: Group Mean as the Unit of Analysis

and

$$\sigma_e = \sqrt{MSE(\text{entities})} = \sqrt{1/2[98/12 + 98/12]} = \sqrt{98/12}$$

[Note that the MSE(entities) is based on the population value $\sigma^2 = \Sigma(X-\mu)^2/N = 98/12$.] The effect size with random, and therefore independent, entities is

$$f = \sqrt{4}/\sqrt{98/12} = \sqrt{(4\cdot 12)/98} = \sqrt{48/98} = .70.$$

Effect Size Estimated for Groups. The effect size that is estimated for groups would require that the group mean be used as the unit of analysis; in this case the data would look like that of Figure 3.4.2. If we use (2.2.3) and (2.2.4) to find the effect size we have that $\sigma_\mu = 2$, since the value does not change when group means instead of entity scores are the units of analysis, then,

$$\sigma_e = \sqrt{\text{MSE(groups)}} = \sqrt{1/2(26/4 + 26/4)} = \sqrt{26/4}$$

and

$$f^* = \sqrt{4}/\sqrt{26/4} = \sqrt{4\cdot 4/26} = \sqrt{16/26} = .78.$$

From equation [3.1.10] we have

$$f^* = f\left(\frac{\sqrt{n_G}}{\sqrt{1 + (n_G-1)\rho}}\right);$$ in this example we have

$$f^* = \sqrt{48/98}(\sqrt{3/[1 + 2(68/98)]}) = \sqrt{48/98(147/117)} =$$

$$f^* = \sqrt{7056/11466} = \sqrt{16/26} = .78$$

which is exactly what was found for f* based on group mean information.

4. POWER TABLES

4.1 Tables in the Appendices

The construction of the power tables for this research paper essentially went through three phases of development. In the first phase the power values were to be generated using Monte Carlo procedures. These procedures and the programs written for them are described in Appendix 1. In the second phase the formulas presented in Section 3.1 were developed after the problem was considered in a multivariate mode. This allowed for the generation of power tables using mathematical procedures and resulted in a tremendous savings of computer time. During these two phases it was felt that the results would show that power does not decrease significantly as the number of entities per unit increased while the total number of entities per cell remained constant. Therefore, power tables were generated where the total number of entities per cell was held constant and the number of units (groups) per cell varied. It was hoped that tables presented in this manner (i.e. where power did not drop significantly when group mean was used as the unit of analyses) would encourage researchers to use groups as the units of analysis. This conjecture was based on some early work with uncorrelated entities per group and was soon found to be incorrect. A comparison between a Monte Carlo generated power table and its mathematical counterpart is shown in Appendix 1. A full set of mathematical tables is found in Appendix 2.

The third phase of development was initiated when the full impact of using correlated entities as units was realized. This took place after a Monte Carlo program was written to examine the effects of correlated units on Type I error. (The program and a mathematical procedure (Walsh, 1947) which yields the same results are shown in Appendix 3.) The results of this program very strongly indicated that if correlated entities are used as the units of analysis in an ANOVA, the probability of making a Type I error becomes unacceptably large. It was felt that this strong evidence (e.g. see Table 1.1.1) would be more persuasive than the expected small loss in power in encouraging researchers to use appropriate independent units. Therefore, two types of power tables were generated that presented power for a given number of groups and entities per group. The first set of tables of this type are shown in Appendix 4 where the population intraclass correlation was set at .20 while the number of treatment levels ranged from two to five; the level of significance varied over .01, .05, and .10; and the entity effect size varied over .10, .25, .40. The intraclass correlation for these tables was set at .20 because this seems to be, see subsection 3.3, a reasonably conservative bench mark to use when schools or classes are the units of analysis. Also, power tables were constructed for a broader range of intraclass correlations; these tables are presented and discussed next in Section 4.6.

To facilitate numbering the tables in the appendices, the four appendices were arranged to correspond to Sections 4.2 through 4.5.

4.2 Appendix 1: Tables 4.2.1 - 4.2.2
4.3 Appendix 2: Tables 4.3.1 - 4.3.36
4.4 Appendix 3: Table 4.4.1
4.5 Appendix 4: Tables 4.5.1 - 4.5.36

TABLE 4.6.1: Minimum Number of Groups (Units) Necessary For Statistical Power To Be Greater Than or Equal to .80 In a One Factor Two-Treatment Level Design

Level of Significance	Number of Entities Per Group	Population Intraclass Correlation .01			.05		
		Effect Size			Effect Size		
		.10	.25	.40	.10	.25	.40
.01	1[a]	572(.80)[b]	93(.80)	38(.80)	572(.80)	93(.80)	38(.80)
	10	64(.80)	12(.81)	6(.82)	85(.80)	16(.83)	8(.87)
	15	46(.81)	9(.81)	5(.85)	67(.80)	13(.83)	6(.80)
	20	36(.80)	8(.85)	5(.93)	58(.80)	11(.81)	6(.87)
	25	31(.81)	7(.85)	4(.85)	52(.80)	10(.80)	6(.90)
	30	27(.81)	6(.82)	4(.90)	49(.80)	10(.84)	5(.82)
	35	24(.80)	6(.86)	4(.94)	46(.80)	9(.80)	5(.84)
	40	22(.81)	6(.90)	4(.96)	44(.80)	9(.82)	5(.86)
.05	1	379(.80)	62(.80)	25(.96)	379(.80)	62(.80)	25(.80)
	10	43(.80)	8(.81)	4(.82)	56(.80)	10(.80)	5(.83)
	15	30(.80)	6(.81)	4(.93)	44(.80)	8(.80)	4(.80)
	20	24(.80)	5(.81)	3(.85)	38(.80)	8(.85)	4(.86)
	25	20(.80)	5(.88)	3(.90)	35(.80)	7(.83)	4(.89)
	30	18(.81)	4(.81)	3(.94)	32(.80)	7(.86)	4(.91)
	35	16(.81)	4(.85)	3(.96)	31(.81)	6(.81)	4(.92)
	40	15(.82)	4(.89)	3(.97)	29(.80)	6(.82)	4(.93)
.10	1	295(.80)	48(.80)	20(.81)	295(.80)	48(.80)	20(.81)
	10	33(.80)	6(.80)	4(.92)	44(.80)	8(.81)	4(.84)
	15	24(.81)	5(.84)	3(.90)	35(.80)	7(.84)	4(.91)
	20	19(.81)	4(.82)	3(.95)	30(.80)	6(.83)	3(.82)
	25	16(.81)	4(.88)	3(.97)	27(.80)	6(.86)	3(.86)
	30	14(.81)	4(.92)	3(.99)	25(.80)	5(.82)	3(.88)
	35	13(.82)	3(.82)	2(.81)	24(.80)	5(.84)	3(.89)
	40	11(.85)	3(.85)	2(.84)	23(.80)	5(.85)	3(.90)

[a] Baseline for independent entities

[b] Statistical power is in parentheses

TABLE 4.6.2: Minimum Number of Groups (Units) Necessary for Statistical Power To Be Greater Than or Equal to .80 In a One Factor Two-Treatment Level Design

Level of Significance	Number of Entities Per Group	Population Intraclass Correlation					
		.10			.20		
		Effect Size			Effect Size		
		.10	.25	.40	.10	.25	.40
.01	1[a]	572(.80)[b]	93(.80)	38(.80)	572(.80)	93(.80)	38(.80)
	10	111(.80)	20(.82)	9(.82)	162(.80)	28(.81)	12(.81)
	15	93(.80)	17(.81)	8(.83)	147(.80)	25(.80)	11(.80)
	20	85(.80)	16(.83)	8(.87)	139(.80)	24(.80)	11(.83)
	25	80(.80)	15(.82)	7(.82)	135(.80)	23(.80)	11(.84)
	30	76(.80)	14(.81)	7(.84)	131(.80)	23(.81)	10(.80)
	35	74(.80)	14(.82)	7(.85)	129(.80)	23(.82)	10(.81)
	40	72(.80)	13(.80)	7(.87)	128(.80)	22(.80)	10(.81)
.05	1	379(.80)	62(.80)	25(.80)	379(.80)	62(.80)	25(.80)
	10	73(.80)	13(.81)	6(.82)	107(.80)	18(.80)	8(.81)
	15	62(.80)	11(.80)	5(.80)	97(.80)	17(.81)	8(.85)
	20	56(.80)	10(.80)	5(.83)	92(.80)	16(.81)	7(.81)
	25	53(.80)	10(.82)	5(.85)	89(.80)	16(.82)	7(.82)
	30	51(.80)	9(.80)	5(.87)	87(.80)	15(.80)	7(.83)
	35	49(.80)	9(.81)	5(.88)	86(.80)	15(.81)	7(.83)
	40	48(.80)	9(.82)	5(.89)	85(.80)	15(.81)	7(.84)
.10	1	295(.80)	48(.80)	20(.81)	295(.80)	48(.80)	20(.81)
	10	57(.80)	10(.81)	5(.85)	83(.80)	14(.80)	7(.85)
	15	48(.80)	9(.82)	4(.81)	76(.80)	13(.80)	6(.83)
	20	44(.80)	8(.81)	4(.84)	72(.80)	13(.82)	6(.85)
	25	41(.80)	8(.83)	4(.86)	69(.80)	12(.80)	6(.86)
	30	39(.80)	7(.80)	4(.87)	68(.80)	12(.81)	6(.86)
	35	38(.80)	7(.81)	4(.88)	67(.80)	12(.82)	5(.80)
	40	37(.80)	7(.82)	4(.89)	66(.80)	12(.82)	5(.80)

[a] Baseline for independent entities

[b] Statistical power is in parentheses

TABLE 4.6.3: Minimum Number of Groups (Units) Necessary for Statistical Power To be Greater Than or Equal to .80 In a One Factor Two-Treatment Level Design

Level of Significance	Number of Entities Per Group	Population Intraclass Correlation					
		.30			.40		
		Effect Size			Effect Size		
		.10	.25	.40	.10	.25	.40
	1[a]	572(.80)[b]	93(.80)	38(.80)	572(.80)	93(.80)	38(.80)
	10	213(.80)	36(.80)	15(.80)	265(.80)	44(.80)	19(.82)
	15	200(.80)	34(.80)	15(.83)	253(.80)	42(.80)	18(.81)
.01	20	193(.80)	33(.81)	14(.81)	247(.80)	41(.80)	18(.82)
	25	189(.80)	32(.80)	14(.82)	244(.80)	41(.80)	17(.80)
	30	187(.80)	32(.81)	14(.82)	242(.80)	41(.81)	17(.80)
	35	185(.80)	31(.80)	14(.83)	249(.80)	40(.80)	17(.81)
	40	183(.80)	31(.80)	14(.83)	239(.80)	40(.80)	17(.81)
	1	379(.80)	62(.80)	25(.80)	379(.80)	62(.80)	25(.80)
	10	141(.80)	24(.81)	10(.80)	175(.80)	29(.80)	12(.80)
	15	132(.80)	23(.81)	10(.83)	168(.80)	28(.80)	12(.81)
.05	20	128(.80)	22(.81)	10(.84)	164(.80)	28(.81)	12(.82)
	25	125(.80)	21(.80)	9(.80)	162(.80)	27(.80)	12(.83)
	30	124(.80)	21(.80)	9(.81)	160(.80)	27(.80)	12(.83)
	35	122(.80)	21(.81)	9(.81)	159(.80)	27(.81)	11(.80)
	40	121(.80)	21(.81)	9(.81)	158(.80)	27(.81)	11(.80)
	1	295(.80)	48(.80)	20(.81)	295(.80)	48(.80)	20(.81)
	10	110(.80)	19(.81)	8(.81)	136(.80)	23(.80)	10(.82)
	15	103(.80)	18(.81)	8(.84)	130(.80)	22(.80)	9(.80)
.10	20	100(.80)	17(.81)	7(.80)	128(.80)	21(.80)	9(.81)
	25	98(.80)	17(.81)	7(.80)	126(.80)	21(.80)	9(.81)
	30	96(.80)	16(.80)	7(.81)	125(.80)	21(.80)	9(.82)
	35	95(.80)	16(.80)	7(.81)	124(.80)	21(.81)	9(.82)
	40	94(.80)	16(.80)	7(.81)	123(.80)	21(.81)	9(.82)

[a] Baseline for independent entities

[b] Statistical power is in parentheses

TABLE 4.6.4: Minimum Number of Groups (Units) Necessary for Statistical Power To be Greater Than or Equal to .80 in a One Factor Two-Treatment Level Design

		Population Intraclass Correlation					
		.50			.60		
		Effect Size			Effect Size		
Level of Significance	Number of Entities Per Group	.10	.25	.40	.10	.25	.40
.01	1[a]	572(.80)[b]	93(.80)	38(.80)	572(.80)	93(.80)	38(.80)
	10	316(.80)	52(.80)	22(.81)	367(.80)	61(.80)	25(.80)
	15	306(.80)	51(.80)	21(.80)	359(.80)	59(.80)	25(.81)
	20	302(.80)	50(.80)	21(.81)	356(.80)	59(.80)	24(.80)
	25	299(.80)	50(.80)	21(.81)	354(.80)	58(.80)	24(.80)
	30	297(.80)	49(.80)	21(.82)	352(.80)	58(.80)	24(.80)
	35	295(.80)	49(.80)	21(.82)	351(.80)	58(.80)	24(.80)
	40	294(.80)	49(.80)	21(.82)	350(.80)	58(.80)	24(.81)
.05	1	379(.80)	62(.80)	25(.80)	379(.80)	62(.80)	25(.80)
	10	209(.80)	35(.80)	15(.82)	243(.80)	40(.80)	17(.82)
	15	203(.80)	34(.80)	14(.81)	238(.80)	39(.80)	16(.80)
	20	200(.80)	33(.80)	14(.81)	236(.80)	39(.80)	16(.80)
	25	198(.80)	33(.80)	14(.81)	234(.80)	39(.80)	16(.81)
	30	197(.80)	33(.80)	14(.82)	233(.80)	39(.80)	16(.81)
	35	196(.80)	33(.81)	14(.82)	233(.80)	38(.80)	16(.81)
	40	195(.80)	33(.81)	14(.82)	232(.80)	38(.80)	16(.81)
.10	1	295(.80)	48(.80)	20(.81)	295(.80)	48(.80)	20(.81)
	10	163(.80)	27(.80)	11(.80)	189(.80)	31(.80)	13(.81)
	15	158(.80)	26(.80)	11(.81)	185(.80)	31(.80)	13(.82)
	20	155(.80)	26(.80)	11(.81)	183(.80)	30(.80)	13(.82)
	25	154(.80)	26(.81)	11(.82)	182(.80)	30(.80)	13(.82)
	30	153(.80)	26(.81)	11(.82)	181(.80)	30(.80)	13(.82)
	35	152(.80)	25(.80)	11(.82)	181(.80)	30(.80)	13(.82)
	40	152(.80)	25(.80)	11(.82)	180(.80)	30(.80)	12(.80)

[a] Baseline for independent entities

[b] Statistical power is in parentheses

TABLE 4.6.5: Minimum Number of Groups (Units) Necessary for Statistical Power To Be Greater Than or Equal to .80 In a One Factor Two-Treatment Level Design

Level of Significance	Number of Entities Per Group	Population Intraclass Correlation .70			Population Intraclass Correlation .80		
		Effect Size			Effect Size		
		.10	.25	.40	.10	.25	.40
.01	1[a]	572(.80)[b]	93(.80)	38(.80)	572(.80)	93(.80)	38(.80)
	10	418(.80)	69(.80)	28(.80)	470(.80)	77(.80)	31(.80)
	15	413(.80)	68(.80)	28(.81)	466(.80)	76(.80)	31(.80)
	20	410(.80)	67(.80)	28(.81)	464(.80)	76(.80)	31(.80)
	25	408(.80)	67(.80)	28(.81)	463(.80)	76(.80)	31(.80)
	30	407(.80)	67(.80)	28(.81)	462(.80)	76(.80)	31(.80)
	35	406(.80)	67(.80)	27(.80)	462(.80)	76(.80)	31(.80)
	40	406(.80)	67(.80)	27(.80)	461(.80)	76(.80)	31(.80)
.05	1	379(.80)	62(.80)	25(.80)	379(.80)	62(.80)	25(.80)
	10	277(.80)	46(.80)	19(.81)	311(.80)	51(.80)	21(.81)
	15	273(.80)	45(.80)	19(.82)	309(.80)	51(.80)	21(.81)
	20	272(.80)	45(.80)	18(.80)	308(.80)	50(.80)	21(.81)
	25	270(.80)	45(.80)	18(.80)	307(.80)	50(.80)	21(.81)
	30	270(.80)	44(.80)	18(.80)	306(.80)	50(.80)	21(.81)
	35	269(.80)	44(.80)	18(.80)	306(.80)	50(.80)	21(.81)
	40	269(.80)	44(.80)	18(.80)	306(.80)	50(.80)	21(.81)
.10	1	295(.80)	48(.80)	20(.81)	295(.80)	48(.80)	20(.81)
	10	216(.80)	36(.80)	15(.82)	242(.80)	40(.80)	16(.80)
	15	213(.80)	35(.80)	14(.80)	240(.80)	39(.80)	16(.80)
	20	211(.80)	35(.80)	14(.80)	239(.80)	39(.80)	16(.80)
	25	210(.80)	35(.80)	14(.80)	239(.80)	39(.80)	16(.80)
	30	210(.80)	35(.80)	14(.80)	238(.80)	39(.80)	16(.80)
	35	209(.80)	35(.80)	14(.80)	238(.80)	39(.80)	16(.81)
	40	209(.80)	34(.80)	14(.80)	238(.80)	39(.80)	16(.81)

[a] Baseline for independent entities

[b] Statistical power is in parentheses

4.6 Minimum Number Power Tables

Tables 4.6.1 through 4.6.5 contain the minimum number of groups that would be necessary to obtain a power value as close to .80 as is possible without becoming less than .80. Cohen (1977, p. 56) proposed that when a researcher "has no other basis for setting the desired power value, the value .80 be used;" this advice was taken in constructing these tables. The tables are for ANOVA's with two treatments (levels) over conditions where the level of significance (α) is .01, .05, and .10; the number of entities per group is 10(5)(40); effect sizes, f's, are Cohen's small (.10), medium (.25) and large (.40). The intraclass correlation is .10 and .05 in Table 4.6.1, .10 and .20 in Table 4.6.2, .30 and .40 in Table 4.6.3, .50 and .60 in Table 4.6.4, and .70 and .80 in Table 4.6.5. Power will increase slightly when more than two treatment levels are present; therefore, these tables provide a reasonable first estimate of sample size when more levels are to be used.

In each table, for each level of significance, the base line is given for the number of entities that would be needed if independent entities served as the units of analysis. For example, in Table 4.6.1 if the population intraclass correlation, ρ, was .01 and $\alpha = .01$ with $f = .10$, then with independent entities we would need 572 entities for power of .80, but we could obtain the same power with 64 groups having 10 entities per group (a total of 640 entities) or 20 groups with 36 entities per group (a total of 720 entities). Notice, however, that as the population intraclass correlation increases the total number of entities increases dramatically when using groups. For example, when $\rho = .70$, $\alpha = .01$, and $f = .10$ we still would only need 572 independent entities for power of .80, but to obtain the same power with groups having 10 entities each, we would need 418 groups or a total of 4180 entities.

A further example of what a value in the tables means can be seen by considering $\rho = .05$, $\alpha = .05$, effect size = .25, and the number of entities per group at 25; then, in Table 4.6.1, there must be at least seven groups per cell for the power to be equal to or greater than .80. In this example, the actual power with seven groups per cell is .83 and power with fewer groups (i.e. six) would be less than .80. Therefore, if a researcher had a design where he felt that the relationship between the twenty-five entities in his groups was .05, he would need at least seven such groups per cell to have the power of his design be equal to or greater than .80. These tables should be very useful to researchers in providing the minimum number of groups needed to obtain minimal power under a variety of interentity relationships.

4.7 Group Power Conclusions Drawn from the Tables

The following conclusions were drawn from the tables generated for this resaerch paper.

1. Educational researchers are used to thinking about power in terms of entities, so that when they think of a design with fewer than twenty units per cell, even if the units are groups, they automatically assume that statistical power will be low (e.g. see Glass and Stanley's quote on page 3 of this report). The power tables in this report indicate that this is frequently not true, and that the number of groups necessary for reasonable power (i.e. power greater than or equal to .80) is largely dependent on the level of significance,

the relationship among the members in a group, the expected treatment effect, and the group size. For example, in Table 4.6.1 if α = .10; the expected treatment effect for independent entities (f) is .40; the relationship among the entities in a group (ρ) is .05, then with only four units of 15 entities (n_G) power is .91; with three units of 40 entities power is .90.

2. When group means are the units of analysis, and there is a positive relationship among the entities in a group, more entities must be in a cell of an ANOVA design than are necessary for the same power when independent entities are involved. This can be observed by considering the baselines for independent entities in Tables 4.6.1 through 4.6.5. For example, in Table 4.6.1, 572 independent entities are necessary per cell for power of .80 when α = .01, f = .10, and ρ = .01, but 10 groups of 64 entities each, or 640 entities, are necessary per cell to achieve the same power with entities in groups. In 4.6.3 when α = .05, f = .25, and ρ = .30, 21 groups of 30 entities per group, or 630 entities, are needed per cell to have power at .80, but only 62 independent entities are needed per cell to achieve the same power.
3. Power drops as the relationship among the entities in a group increases. This can be seen in Tables 4.6.1 through 4.6.5 because as the value of ρ increases more groups are necessary to achieve power that is greater than or equal to .80. This can also be seen by considering Tables 4.3.5 through 4.3.8. In these tables the number of entities per cell was held

constant at 40 while ρ varied over the values 0.0, .20, .50, and .80. Power in Table 4.3.5 (ρ=0.0) when there is four treatment levels with ten units of four entities each across ρ = .01, .05, and .10 is .94, .99, and 1.00. In Table 4.3.6 (ρ=.20) power with the same parameters has dropped to .73, .91, and .95; in Table 4.3.7 (ρ=.50) power is .47, .73 and .83; in Table 4.3.8 (ρ=.80) power is .32, .58, and .71.

4. As group size increases more entities per cell are needed to obtain the same power--this result is similar to that in the second conclusion. This can be seen by observing Tables 4.6.1 through 4.6.5. Here for every value of ρ the number of entities per cell needed to achieve power greater than or equal to .80 increases as the number of entities per group increases. For example, in Table 4.6.1 when α = .10, ρ = .05, and f = .10 as the number of entities per group increased from 1 through 40 the number of entities per cell increased as follows: 295, 440, 525, 600, 675, 750, 840, and 920.

5. Given conclusions 3 and 4, the reduction in power is much more severe with lower levels of significance. For example, consider a design with the following parameters: 2 levels,

   effect size = .40, number of groups = 20, n_G = 5.

   Then, power is .93, .99, and .99 at α = .01, .05, .10 in Table 4.3.18 (ρ=.20) but drops to .71, .90, .95 in Table 4.3.19 (ρ=.50). Here there is a drop in power of 24% for at α = .01 but only 9% at α = .05 and 4% at α = .10. A similar situation exists when the number of entities in a unit increases. For example, in the preceding design with 5 entities per unit in Table 4.3.19 power for $\alpha = .01, .05, .10$ was .71, .90, .95, and with 10 entities per unit it dropped to .35, .64, and .76, a corresponding reduction of 51% at $\alpha = .01$, 29% at $\alpha = .05$ and 20% at $\alpha = .10$. These results would encourage researchers to use more liberal levels of significance, if possible.

The last result is not immediately evident from the tables, but might be intuitively obvious when given some consideration. It was discovered in constructing Tables 4.6.1 through 4.6.5.

6. Power may drop severely when a small number of groups is being used and one or more groups is (are) lost. The strongest example of this case occurs in Table 4.6.1 when we consider the design with parameters: $\alpha = .10$, $\rho = .01$, $f = .40$, $n_G = 40$. Here only two units are necessary for power to be .84, but what happens when a unit is last? This means that in one cell we have only one unit and there is no power. Another example occurs when the design has parameters: $\alpha = .01$, $\rho = .01$, $f = .40$, and $n_G = 25$. Power for this design is .85 with four units per cell, but becomes .52 with three units per cell.

5. USE OF THE EQUATIONS AND TABLES: EXAMPLES

5.1 Introduction

Each of the six examples presented in this section was constructed to illustrate one or more facets in the use of the equations and tables developed earlier. In the first example sample size and power are found in a step-by-step fashion. This example should prove to be valuable for practitioners involved in educational research experiments who are unable to expend time on other parts of this paper. The second example illustrates how an education researcher might attempt to calculate sample size and power using the available formulas for entities. The reader is taken from these entity formulas to those for groups where the value of considering the magnitude of the interrelationship among individuals in a group and the size of each group are considered. Also, in Example 2, several ways to manipulate sample size and still have high power are considered. In the third example, we consider the case where a large treatment effect is expected and where the interrelationship among the entities in a group is low. In this case it is shown that power can be very high with only a small number of groups per treatment. All of the first three examples use the simplest design, two treatments and one factor, as a focal point. The fourth example has a design with five levels where the problem is to keep the number of groups as small as possible given a fixed number of entities. In the fifth example there are three levels where the interrelationship among entities within groups is high, and we consider ways of reducing this high value. Finally, in the sixth example there are four treatment levels and sample size and power are calculated based on information available from past research.

5 . Example 1

This example was written in a step-by-step manner for those educational researchers and evaluators who are unfamiliar with statistical power analysis. The design considered in this example is the simplist one possible where we have one factor and two levels. The design is illustrated in Figure 5.1.1 where the factor is simply called Factor 1 and the levels are labeled treatment and control.

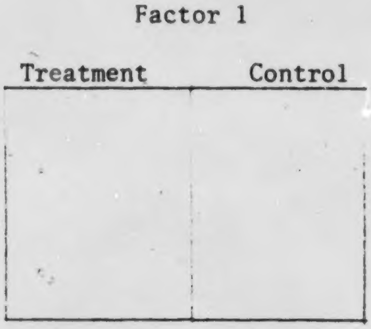

Figure 5.2.1: A Simple One Factor Two Level Design

The researcher is able to randomly assign classrooms to each of the factor levels, but he cannot randomly assign pupils to the two conditions. Therefore, he would like to know how many classrooms should be randomly assigned to each factor level--the steps he should take follow.

Step 1: Determine the level of significance.

Example: In this example the researcher selected .05 as the level of significance (α).

Step 2: Determine the magnitude of the treatment effect (f): small, f = .10; medium, f = .25; and large, f = .40. (See section 2.1, under Cohen's Tables, for a further discussion of effect size (f).)

Example: Effect size was set at f = .25.

Step 3: Determine the strength of the interrelationship (ρ) among the students in a class. To select ρ the researcher should take into consideration how and when the class was formed and how long the treatments will last. The following table should serve as a guide in selecting ρ.

Group Formation When	 How	Treatment Length	Interrelationship (ρ)
new	close to/or random	short	.05-.10
new	close to/or random	long	.10-.20
new	by ability	short	.50-.60
new	by ability	long	.70-.80
old	close to/or random	short	.10-.20
old	close to/or random	long	.10-.20
old	by ability	short	.70-.80
old	by ability	long	.70-.80

Example: In this example the researcher had a class that has been together for more than one month i.e. it is old; and is balanced with respect to ability, i.e. close to random; and the treatment would take less than one month, i.e. it is short. Therefore, the researcher selected ρ = .20 to represent the interrelationship among the students in a class. (If classes are homogeneously grouped by ability see example 5.)

Step 4: Determine the approximate class size.

Example: Most of the classes available to the researcher contain about twenty students.

Step 5: Determine the minimum power for this design, i.e. the probability of rejecting the null hypothesis when it is false.

Example: The researcher decided that if there were differences between the factor levels, then he would like to detect them with probability equal to or greater than .90.

Step 6: Use the tables presented here, Cohen's tables, or Tang's Charts to help determine an appropriate number of groups (classes) per treatment.

Example: Tables in Appendix 4: Using the parameters found in the preceding steps, i.e. $\alpha = .05$, $f = .25$, $\rho = .20$, entities per unit (class size) = 20, minimum power = .90, and the fact that there are two treatment levels, the reseacher can turn to Table 4.5.17 in Appendix 4 to find that 25 classes (units) per treatment level will yield power of .95 and that 20 classes per treatment level will yield power of .89.

Example: Cohen's Tables: Cohen (1977) presents power tables for various effect sizes. To use them our researcher needs to calculate the effect size based on related groups using the formula

[3.1.10]

$$f^* = f \frac{\sqrt{n_G}}{\sqrt{1 + (n_G - 1)\rho}} .$$

Here we have that $f = .25$; n_G = number of students per class = 20; and $\rho = .20$, therefore,

$$f^* = .25(\sqrt{20}/\sqrt{1 + (20-1).20})$$

and

$$f^* = .51.$$

Cohen (1977, p. 311) indicates that power for f* = .50 is .89 when the number of classes is 21 and is .91 when the number of classes is 22. (Note that our f* is .51 so that we could expect power to be slightly larger than what is found in Cohen's table.)

Example: Tang's Charts: Tang's charts are available in many intermediate level statistics books, e.g. Dixon and Massey (1969, pp. 524-531), Glass and Stanley (1970, pp. 548-551), Johnson and Leone (1977, pp. 1029-1032), and Kirk (1968, pp. 540-547). To calculate power we must find ϕ^* using formula [3.1.11]

$$\phi^* = \sqrt{G}\, f^*$$

where G is the number of classes (groups) per treatment. In the preceding paragraph we found f* = .51 so we can substitute different numbers of classes for G and use Tang's charts to see if we have selected a sample size large enough to have power greater than or equal to .90. For example if we set G = 16 then $\phi^* = .51 \cdot 4 = 2.04$. To use Tang's charts we need the degrees of freedom for treatments which is one minus the number of factor levels or in our case 2 - 1 = 1; and the degrees of freedom for error which is the sum of the number of units in each cell minus the number of cells or here 32 - 2 = 30. Then power in Kirk (1968, p. 540) is approximately .80; if G = 25 then $\phi^* = 2.55$ and power is (df = 1,48) approximately .95. Therefore, the researchers would randomly assign 25 classes to each treatment and be relatively sure of detecting treatment differences if they exist.

5.3. Example 2

In this example a researcher is interested in the effect of Biological Sciences Curriculum Study's, BSCS, inquiry slides on the critical thinking ability of first-year high school biology students.[1] The problem is: "Does implementation of audio-visual inquiry-oriented teaching aids improve the critical thinking ability of students that have had this form of educational exposure" (Story and Brown, 1977, p. 341)? The design for this study is that shown in Figure 5.1.1 where an educational researcher is able to randomly assign first year high school classes to either the treatment level that receives instruction using BSCS slides or instruction without the use of the BSCS slides. The project is funded by the state of Ohio and the population consists of all the first year high school classes in the state. The dependent variable was measured by the Watson-Glaser Critical Thinking Appraisal test. The researcher would like to know how many first year high school classes need to be assigned to each treatment. He has selected the level of significance at .05 and he knows that he will have around 25 students in each of his classes. Each of the following procedures are available to help him establish a sample size that is large enough to have a high probability of rejecting his null hypothesis of no population treatment mean differences. In each procedure the most important step is to decide on the mean differences the researcher feels are important to detect.

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[1] This study is fictional but it was motivated by a study completed by Story and Brown (1977). Interestingly, in the study by Story and Brown, they used the student as the unit of analysis when they should have used the classroom.

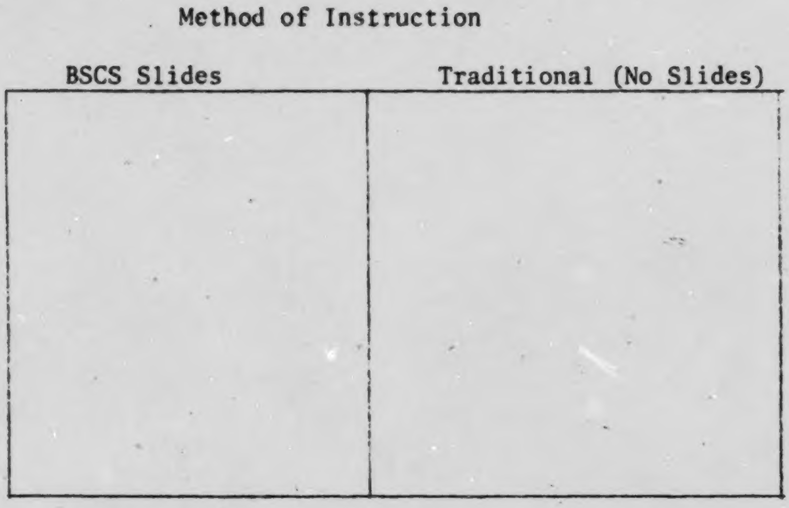

Figure 5.3.1: Example 2: Traditional Versus BSCS Method of Instruction

Procedure 1: $c\sigma_{e_G}$

One approach to selecting sample size is to follow the procedure described earlier in section 2.1 under Tang's charts and to select mean differences as large as $c\sigma_{e_G}$. Using this approach, and the fact that the sum of the mean differences, $\sum_{j=1}^{J} \beta_j$, is at its minimum when equal to $c^2\sigma_{e_G}^2$, the researcher can use $\phi^* = \sqrt{G}\sqrt{c^2/2J}$ to help find G the number of groups (classes) needed per treatment. In this example the researcher decided that a mean difference larger than or equal to .25 σ_{e_G} would be important enough to cause the state to encourage schools to use the BSCS system and to provide financial support for this change. Substituting .25 for c, and 2 for J (treatment levels), in our formula for ϕ^* we have

$$\phi^* = \sqrt{G}\,\sqrt{(.25)^2/2\cdot 2}$$

$$\phi^* = \sqrt{G}\,(.125)$$

If we let G = 100 then $\phi^* = 1.25$, degrees of freedom for treatments is 1 and for error is 192 or ∞ for the charts, and power (Kirk, 1968, p. 540) using Tang's charts is less than .50. Therefore, we increase G to 400 and $\phi^* = 2.5$ with power approximately equal to .94. The researcher would need 400 classes per cell (total number of groups, N_G, is 800) in order to detect mean differences on the order of $.25\ \sigma_{e_G}$ with probability = .94.

The latter result could also be arrived at using Cohen's effect size. Using formula (3.1.12) for groups we have

$$f^* = \phi^*/\sqrt{G} = f^* = 2.5/20 = .125$$

In Cohen (1977, p. 312) we have, through interpolation, that power is approximately .94.

The researcher has found that he needs 800 classes in order to have a high probability of detecting a difference of the magnitude of $.25\ \sigma_{e_G}$. Even with state resources this is an unacceptable number of classes; it is much too large. The logistics alone involved with 800 classes (20,000 students) would be extremely difficult to handle. What are his choices? To reduce sample size a researcher may: (1) increase his level of significance, (2) reduce the experimental error, (3) use a one-tailed test, (4) reduce power, or (5) some combination of the preceding four. Each of the latter steps is possible in this study, but let us first consider what is wrong with the researcher's reasoning.

What the researcher using the preceding procedure has overlooked is that his units are not individuals but groups and that the standard deviation based on group mean is generally much smaller than that based on entities. For example, if the subjects in his classes were independent of one another, i.e. $\rho = 0$, then we have from formula [3.1.3] that

$$\sigma_{e_G} = \sigma_e/\sqrt{n_G} = \sigma_e/5.$$

This is the well known standard error of the mean for independent subjects, and one can see that σ_{e_G} is one-fifth the size of the variance of the subjects, σ_e. Therefore, the solution to the problem presented above is to select a larger value for the mean difference that we would like to detect and to take into consideration the values of n_G

and ρ in formula [3.1.3]. This adds a new fifth step to our list of ways to reduce sample size: increase the size of the mean difference that you would like to detect as significant. In most cases this new step might seem a bit like cheating, but it is clearly reasonable in the case of our researcher because he had overlooked the fact that his error variance would significantly decrease when he used groups. Therefore, he was trying to detect an extremely small treatment effect for which he would need a very large sample size.

To help select a more reasonable treatment difference in terms of σ_{e_G} the researcher might consider formula [3.1.3] with $n_G = 25$ and $\rho = .20$. This value for ρ is probably conservative as was noted in section 3.3. Here we have that

$$\sigma_{e_G} = \sigma_e \frac{\sqrt{1 + (n_G - 1)\rho}}{\sqrt{n_G}}$$

$$\sigma_{e_G} = \sigma_e \frac{\sqrt{1 + (25-1).20}}{\sqrt{25}}$$

$$\sigma_{e_G} = \sigma_e(.4817) \simeq \sigma_e(.50),$$

The error variance with groups will be approximately one-half what it would be if independent entities were used. Therefore, the researcher would want to detect treatment differences that were twice the size of his original estimate; in this case $2(.25\ \sigma_{e_G}) = .50\ \sigma_{e_G}$. Given this information, we have that

$$\phi^* = \sqrt{G}\ \sqrt{(.50)^2/2\cdot 2} = \sqrt{G}(.25), \text{ and}$$

if $G = 100$, we have that $\phi^* = 2.5$ with power approximately .94.

This same result would be arrived at for Cohen's effect size where

$$f^* = \phi^*/\sqrt{G} = 2.5/10 = .25$$

This is Cohen's medium effect size and in his book (1977, p. 312) for 100 units and $f = .25$ we have that power = .94. What we have done by considering class size and the intercorrelation among the units is to reduce the total sample size from 800 to 200, a sizable reduction.

Further reduction in sample size might be accomplished by: 1) increasing the level of significance to .10, here power is .94 for $G = 80$, $N_G = 160$; 2) reducing the experimental error, here by improving our measuring device or by using a block design and blocking on an important variable such as past achievement--both of these would allow us to reduce σ_{e_G} and increase c and affect size; 3) perform a one tailed test, here Cohen's $d = 2f$ (for a one tailed t-test) and power (p. 31) is .94 for $G = 84$, $N_G = 168$; 4) reduce the power, here if we set our minimum power at just greater than or equal to .80 we have that power is .81 for $G = 64$, $N_G = 128$; and, 5) if we consider steps 1, 3, and 4 we have that for $\alpha = .10$, a one tailed t-test, with reduced power, that power is .80 (Cohen, p. 32) with $G = 36$, $N_G = 72$. As can be seen an experimenter who is willing to think about his design in advance has a good deal of flexibility in selecting a sample size that will give him a good chance of detecting a meaningful difference between treatment means.

Procedure 2: $c\sigma_e$

The latter procedure for this example is somewhat awkward to compute because one is attempting to deal with treatment differences in terms of σ_{e_G} which will vary according to N_G, group size, and ρ, the relationship among the subjects in a group. Implicit in the latter half of our discussion in Procedure 1 was the use of σ_e, the standard deviation based on entities, to help determine an appropriate c for $c\,\sigma_{e_G}$ in order to determine mean treatment differences. The use of σ_e to help estimate treatment differences is more reasonable because: 1) it is the measure we are used to using to estimate treatment differences and effect sizes, 2) it is unaffected by differences in n_g and ρ, and 3) as was seen in the example in section 3.4, the treatment means remain the same regardless of whether groups or entities are the units.

Perhaps the simplest way to determine treatment differences in terms of σ_e is to use Cohen's effect size which is based on σ_e, i.e. $f = \sigma_\mu/\sigma_e$. Since Cohen has provided benchmark effect sizes of .10, small; .25, medium, and .40, large, it is easy to select one of them and then to calculate the effect size, f*, when groups are the units of analysis using formula [3.1.10]. For example, in comparing BSCS and traditional methods of instruction we could select a medium effect size (based on entities) of .25 and then use formula [3.1.10] to calculate the effect size based on groups of 25 students with the relationship (intraclass correlation) among the students in each group estimated to be .20. Then,

$$f^* = (.25)\sqrt{25}/\sqrt{1 + (25-1).20}$$

$$f^* = .25 \times 2.08$$

$$f^* = .52 \simeq .50,$$

and when $\alpha = .05$ we have that $G = 25$, $2G = 50$ and power is .94 (Cohen, p. 311). That is, if the researcher is interested in detecting a medium effect size between his treatment means he will need 25 classes in each treatment to have a probability of .94 of detecting a treatment mean difference this large

Table 4.6.2 indicates that 16 classes would be needed to have power equal to or greater than .80 here .82, when $f = .25$, $\alpha = .05$, and $\rho = .20$. This value can be found for $f^* = .52$ in Cohen (p. 311), using interpolation.

Note that in using Procedure 1 in this example we had $f^* = .25$ so that our effect size based on entities was

$$.25 = f \cdot 2$$

$$.125 = f$$

using formula [3.1.10]. This is a rather small effect size and it resulted in the need for 100 classes per treatment.

5.4. Example 3

In this example the researcher is interested in examining the effects of the Cuisenaire method of learning arithmetic in third grade.[1] The research hypothesis was that the cuisenaire method would improve third grade student achievement.[2] The population consisted of all third grades in the province of Manitoba and the dependent variable was measured by a locally constructed and validated mathematics achievement test. The design was similar to that shown in Figure 5.1.1 with the treatment levels being the Cuisenaire and Traditional methods of instruction. Past research (Lucow, 1964) had shown that the Cuisenaire method of instruction was far superior to the traditional approach and so the level of significance for this study was placed at .01 and the entity effect size was set at .40.

In this study 20 students were randomly assigned to each class and since the Cuisenaire method is used as a way to begin learning arithmetic the experiment was conducted during the first two months of school. Under these conditions the researcher posited that there would probably not be a strong relationship among the students and therefore he selected .05 as the measure of intraclass relationship. We then have the following information with which to calculate an appropriate sample size and power:

---

[1] This example is fabricated but was based on a study by Lucow (1964). Unfortunately, Lucow used students as the units of analysis when he should have used classes.

[2] Although many researchers might consider the use of a one-tailed test with this hypotheses, a two-tailed test and its corresponding power are considered here. See Cohen (1965) for a discussion of this point.

$$f = .40$$

$$\alpha = .01$$

$$n_G = 20$$

$$\rho = .05$$

Using this information we have from Table 4.6.1 that if six such classes are assigned to each treatment the power of our statistical test will be .87. Furthermore, using equation [3.1.10] we have that $f^* = 1.28$ and equation [3.1.11] that $\phi^* = 3.14$. This illustrates one limitation of Cohen's tables with groups as units, the tables are limited to maximum effect sizes of .80. In this respect Tang's charts are better in that the tabled values of ϕ are quite large--for one degree of freedom with $\alpha = .01$, ϕ ranges between 2 and 5; for $\alpha = .05$, ϕ ranges between .5 and 3.8. An important point illustrated in this example is that with large effect sizes relatively small numbers of groups (between 2 and 15) are needed for power greater than .80 when the intraclass correlation is low (less than or equal to .20).

5.5. Example 4

One area of educational research where the importance of using the group mean as the unit of analysis has been recognized is in research on the effects of media on instruction (Lumsdaine, 1963). For instance, this example was suggested by a study completed by Gladstone (1958) where he was interested in determining whether readability formulas that had been applied to written material could be applied to educational film commentaries. In our example study we consider five treatment levels each consisting of a commentary on the same film but with the degree of difficulty of the film commentary varying from that considered appropriate for fourth graders to that considered appropriate for fifth graders--see Figure 5.4.1.

Film Commentary Difficulty

4th Grade	5th Grade	6th Grade	7th Grade	8th Grade

Figure 5.4.1: One-Way ANOVA Design for Example 3

The Dale-Chall readability formula (Dale and Chall, 1948) was used to determine commentary difficulty. Our study takes place in a large city school system where eighth grade students will be randomly sampled from schools and then randomly assigned as a group from a school to one of the treatment levels. As in most experiments cost was very important and this is why students appeared as groups from schools, so that they could be bused to the theater where the film was being shown. In this study the experimenters were looking for a large effect size of .40; had selected alpha to be .05, and had decided that a good measure of interrelationship among the students in a school would be represented by an intraclass correlation of .20. Since expense of transportation and school involvement was important, the researchers wanted to have as few units (school groups) as was possible, but they were limited to a theater with only one hundred seats. Therefore, to find statistical power, the tables shown in Appendix 2 were used. Table 4.3.18 indicates that for 100 entities (students) statistical power is .84 with only 5 units of 20 entities per unit. Furthermore, Table 4.5.24 in Appendix 4 indicates that if the group size is increased to 25 students with 4 units power drops to .72. Therefore, the researchers needed twenty-five schools for this study with twenty students randomly selected from each school.[1]

5.6. Example 5

In this example, the researcher is interested in examining the effects of three methods of teaching beginning reading to second graders. His population consists of all the classes in a large county in New York State. The students in this county are placed in tracks according to their ability; therefore, as was shown in section 3.3, the intraclass correlation among the students in a class could be expected to be as high as .80. By observing Table 4.6.5, the researcher realized that his sample would have to contain more classes than his budget would allow. For example, if he had approximately 25 students per class and had selected an effect size of .25; alpha = .05, then he would need 3 x 50 = 150 classes to have power of approximately .80.[2] In this case the researcher would want to reduce the error variance (increase the effect size) by removing the variation due to ability tracking in the design. This can be done in two ways: 1) by randomly assigning classes to treatments within blocks of ability, or 2) by performing an analysis of covariance to remove variation due to ability.

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[1] It is recognized that this study is an example of two-stage sampling: stage 1, sample the schools; stage 2, sample the students within the schools (Cochran, 1963), but the power calculations should not change appreciably.

[2] Power shown in these tables is for two levels; it will be slightly higher for three levels.

In both of these cases the group mean is still used as the unit of analysis. In the analysis of covariance what we are doing is similar to removing the linear relationship due to ability among the subjects, i.e. reducing the intraclass correlation to say .30 (this analysis assumed homogeneous slopes within treatments). If the relationship were .30, then the number of classes needed would be (see Table 4.6.3) 21 per treatment level--less than half of that needed when $\rho = .80$. Another way of considering the same problem is that ρ is still .80, but we are increasing the effect size by reducing the error variance. For example, if the effect size increased to .40, then, (Table 4.6.5) we will need 21 classes per treatment in order to have power of .81. The researcher could now consider some of the ways to decrease sample size discussed in Example 2 if 21 classes per treatment was still too many, or he could use formula [3.1.10] or [3.1.7] to find out how many classes are needed for more power.

5.7. Example 6

In all of the previous examples we dealt with power estimates that were based on population values. For example, we always dealt with effect size, f or f*, which is the ratio of the population variance of the treatment means, σ_μ^2, to the population variance of the units of analysis, σ_e^2 or, in considering treatment effects, we discussed differences between population means as a function of a multiple, c, of the population variance of the units of analysis. Another way to arrive at estimates with which to calculate power is to use past research to arrive at estimates of σ_μ^2 and $\sigma_{e_G}^2$ and to use the estimated values to find f* or ϕ^*. A word of caution is necessary here, however, because Carroll and Nordholm (1975) have indicated that measures of association have large standard errors with small sample sizes. Since f, and therefore f*, is related to the measures of relationship discussed by Carroll and Nordholm it would also be expected to have a large standard error with small sample size. The researcher should be aware of this problem and treat estimates of f and f* with caution when $N_G < 100$.

When data from a past study with large N_G is available the calculation of power is relatively simple. For example, if in a reading methods study past research indicated that the estimate of the population mean differences, $\hat{\sigma}^2_\mu$, was 25 and that the estimate of the unit variance for groups, $\hat{\sigma}^2_{e_G}$, was 400 then we have that

$$\hat{f}^* = \frac{\hat{\sigma}_\mu}{\sigma_{e_G}} = \frac{\sqrt{25}}{\sqrt{400}} = 5/20 = .25.$$

Then, if $\alpha = .01$ and there were four factor levels power could be determined using Cohen (1977, p. 294) where with 80 units per cell power was found to be .91. Note that since group information was present it was not necessary to estimate the intraclass correlation nor consider group size.

6. EPILOG

6.1. Introduction: Loose Ends

At this point in the paper there are a few disjointed loose ends that should be discussed which didn't seem to fit into earlier sections. They are presented next and are followed by a more clearly connected discussion of the assumptions made in the mathematical model used to derive the equations in Section 3 and some of the more recent literature on the topic of unit of analysis.

Higher order designs. The main focus of this paper has been on one-way ANOVA's. Fortunately, however, once power calculations are firmly in place for this simple design they can be extended in a fairly straight forward fashion to higher order designs. This process is well illustrated in books like Cohen (1977), Guenther (1964), and Kirk (1968). For example if we consider a two-way ANOVA then the number of groups necessary to detect significant mean differences at each level is slightly more than that needed when each factor is considered separately as a one-way ANOVA. This is because the degrees of freedom for error decrease in the two-way ANOVA due to the inclusion of additional sources of variation. To compensate for this decrease Cohen (1977, p. 365) suggests that the G (number of units) used for table entry be found using

$$G' = \frac{\text{within cell (error) df}}{\text{number of treatment levels}} + 1.$$

For example, in a design with three levels on factor A and five levels on factor B with $\alpha = .10$; $\rho = .20$; $f = .40$; $n_G = 30$; if there were 2 groups in each cell, we have that for the three treatment levels

$$G' = \frac{5 \cdot 3(2-1)}{3} + 1 = 6.$$

Then in Table 4.5.34, power for the F-test on factor A is .91 when 6 is used as the number of units to enter the table instead of 10 which would be used for a one-way ANOVA on factor A alone.

Comment on the examples. The examples in this paper concentrated on studies which take place in locations were a large number of groups are available and where generalizations about groups would be beneficial. This type of study appears to make the most sense for educational researches at the city, county, state, national, or international level. Welch and Walberg (1972) make a convincing plea for experiments at this level when they concluded:

> With respect to national curriculum experiments, we conclude that they are feasible and necessary. Not only do they meet canons of broader inference, but they are more convincing to evaluation consumers. Our liberally-estimated extra costs of a national, over a regional experiment, are $1000 for random sampling, long distance calls, mailing and $8,500 in transportation expenses for bringing 57 teachers to Cambridge, Massachusetts from various parts of the country. Compared to the developmental costs of a government-sponsored high school science course, which often runs into millions of dollars, the benefits of national experiments (and other evaluation activities) seem worthwhile. (p. 382)

The tables provided in this report should be helpful in planning such experiments.

Groups where $\rho = 0$. The following comment by Peckham, Glass and Hopkins (1969) warns researchers not to use the group as the unit of analysis just because it exists.

> On the other hand, one can conceive of some experimental settings where membership in a class would be unrelated to dependency. For example, little or no dependency would be generated in a study of the relative merits of two different kinds of answer sheets for a standardized test. Similarly, if treatments consisted of alternate methods of presenting material in a programmed learning sequence, dependency would be unlikely to arise as students worked through the program individually. (p. 343)

The point to be made is that in such a situation (i.e. $\rho = 0$) it would be foolish to use the group as the unit of analysis because it would be wasteful of power.

A nested design. Peckham et al. (pp. 345-346) suggest that educational researchers make use of a nested design where groups are nested within treatments and other variables enter the design as blocks. In this design they suggest that differences among groups be tested first, and if this difference is not significant then the subject may be used as the unit of analysis. The latter test is equivalent to testing that the intraclass correlation is equal to zero. The problem with this approach is that it is done after the experiment has been carried out and no concern is shown *a priori* for the number of groups per treatment. What does a researcher do when he finds that there is significant variation between groups (i.e. that $\rho > 0$) but that his statistical power based on groups is very low? Also, the test of significance of between group variation will generally have poor power so that no group differences will usually be found. One only has to consider the increase in the probability of Type I error when subjects are related, even to a small degree, to realize that the nested design approach discussed by Peckham et al. should be considered with caution, if at all.

6.2. Model Assumptions

In developing the formulas in Section 3 certain assumptions were made about the mathematical model used to calculate power from grouped data. The questions considered here are: How well does this model actually reflect classroom and/or school data?--and, if it doesn't, how well does the F-test withstand violations of the model's assumptions?

The latter questions appear difficult to answer and will probably require further research. Part of the difficulty in answering them is due to the fact that the model assumptions in Section 3 were made at two unit levels: entity and group. At the entity level the assumptions[1] made were that: 1) the observations in a group were sampled from a multivariate normal distribution with equal variances, and 2) the average intercorrelation based on each pair of entities in a group was assumed to be equal across groups. At the group level the assumptions were those regularly made in an ANOVA, namely that: 1) the groups in each treatment have a normal distribution, 2) the variances of the groups from each treatment are equal, 3) the observations in each treatment are independent of one another, and 4) each observation may be described by a linear equation composed of the grand mean of all observations, a treatment effect, and an error component.

It is difficulty to see what effect violating the assumptions at the entity level will have on the assumptions at the group level. It certainly seems possible that one could have a situation were the entity level assumptions are violated but there is no violation of the assumptions at the group level. For example, the central limit theorem indicates that even if each sample of entities was taken at random from a rectangular distribution the distribution of their group means would satisfy the group level assumptions. What is known is that the F-test is robust to violations of the group level assumptions (Glass, Peckham and Sanders, 1972). In this light perhaps violation of the entity level assumptions will not seriously effect calculation of the power values as demonstrated here because the entity level estimates of ρ are based on an ANOVA between groups and an estimate of ρ is directly related to the robust F. That is the intraclass correlation can be written as a function of F, here for J treatment levels Haggard (1958, p. 19) gives

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[1] A further assumption was that there were an equal number of groups per treatment and that each group contained an equal number of entities. Since we are dealing with reasonable ('ballpark') estimates of power and sample size based on population values variations here should not be a major problem. Cohen (1977, pp. 359-364) presents a discussion of power calculation when there is an unequal number of observations per treatment.

$$R = \frac{F-1}{F + (J-1)}$$

However, in the next section we will discuss one important situation where effects at the entity level are of concern to researchers at the group level. Also, we shall see that educational research methodologists have already begun work on the problem of what information about entities can be used to make statements about groups and vice versa.

Entity Aptitude-Treatment Interaction

In the past decade educational research methodologists have become much more sensitive to the issues involved in using students verses classes or schools as the units of analysis. This can be seen by considering the writings of Boch and Wiley (1967); Peckham, Glass and Hopkins (1969); and Wiley (1970) versus those of Burstein (1978); Burstein, Linn and Capell (1978); Cronbach (1976); Knapp (1977); Lohnes (1972); and Wiley (1976).[1] In the earlier writings there was much more concern over the use of the appropriate unit of analysis while in the later writings more concern is shown for choosing an appropriate analytical model for analyzing classroom and school data. The analytical analyses most frequently discussed involve a regression model approach where both entity and group information is contained in a regression equation (Burstein, et al. 1978). The importance of attempting to find an appropriate analytical model that takes into account both student and class or school information appears to have grown out of Cronbach and Snow's (1976) work on aptitude-treatment interaction (Cronbach, 1976). It was recognized that in a study where treatment effects were based only on classroom or school means that the results could fail to reflect aptitude-treatment interactions within classes or schools. That is, students within classes might react differently to teacher/treatment effects. This would be reflected in heterogeneous regression slopes within classes when student post-test scores were regressed on their pretest scores. Importantly if this were to occur at the entity level it might not violate an ANOVA assumption at the group level. Unfortunately, Burstein et al. (1978) report, that of three analytical models proposed "all yielded misleading estimates of the magnitude of teacher/class effects on mean class outcome (p. 377). Therefore, further research is needed on this important problem.

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[1] Sociologists and economists appear to have been more concerned with problems of aggregation (grouping) and dissagregation, see for example: Feige and Watts (1972); Hannan (1971); Robinson (1950); Scheuch (1966): Shively (1969).

In considering this paper in light of the recent attention given to the possibility of heterogenous within class regression slopes it should be recognized that the problem can be viewed from several vantages. This paper is concerned with making generalizations at the group level (i.e to other groups); in this light the procedures outlined in Section 3-5 are reasonable. That is, they allow one to arrive at appropriate sample sizes to make accurate probability inferences about groups. This is fine when group information is what is desired; particularly so when educational policy in a school or district would make it difficult to take into account aptitude-treatment interactions. For in this case even if these interactions within classes were responsible for no treatment differences, statements at the class level are very important. However, in most cases, reseachers wull not want to stop with group information, but will want to continue to dig into explaining what is happening within classes; this is particularly true when educational policy allows for actions that can take into account aptitude-treatment interactions.

Another reason for focusing attention on what is happening within a class is that it may help to explain the reason for a group observation which is labeled an outliner. For example, a class mean could be adversely affected if a teacher were to die or if an individual or clique of individuals were to severly disrupt or motivate the class. It should be standard procedure to calculate measures of mean, standard deviation, skewness and kurtosis on each class both before and after treatment (Lohnes, 1972).

Conclusion

In the preceding section, the discussion was focused on the mathematical model underlying the power calculations found in previous sections. The assumptions made in using this model were found to be at two levels: those for entities and those for groups. While it must be left for future research to decide on the robustness of the procedures discussed in earlier sections, these procedures should provide educational researchers who are planning field experiments with insight into the number of groups to randomly assign to treatments--even if the assumptions made at the entity level are violated. This discussion of group and entity levels is appropriately concluded with the following fallacy definitions disucussed by Scheuch (1966):

> The group fallacy (and, as a special case, the ecological fallacy) results from the difference between units of observation and units of inference. The danger of committing this fallacy is always present when the unit to which the inference refers is smaller than the unit either of observation or of counting. (p. 164)
>
> The danger of the individualistic fallacy is then present when units of observation or counting are smaller than the units to which inferences are made. (p. 164)

It is hazardous to make inferences to classes when your focus is on students, and to make inferences to students when your focus is on classes--*ceterus paribus*.

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APPENDICES

APPENDIX 1

The Monte Carlo (RPOW) and Mathematical (MBAR) Computer Programs Used to Generate Power Values When Group Mean is the Unit of Analysis; With a Comparison of Their Tabled Output

A.1. Introduction

This Appendix contains two programs that were used to generate power tables. The card input used to output specific tables in the appendices is also given along with the execution time. The first program that is presented is called "RPOW"; in it power values are generated for groups using Monte Carlo techniques. The second program that is presented is called "MBAR"; in it power values are generated for groups using a mathematical procedure. A comparison of the tabled power values from these two programs is found in Tables 4.2.1 (RPOW) and 4.2.2 (MBAR). Both programs hold the total number of entities in a treatment (cell) constant at 40, but vary the number of groups over 20, 10, 5 and 2. These tables provide evidence that both methods yield accurate power values. The largest discrepency occurs when there are only two observations (units) per treatment and two treatments. In this case the Monte Carlo program may be more accurate because the mathematic procedure yields unreliable results for very small power values, i.e. values less than .10. Generally, however, the power values are within ±.04 of each other.

The method used to generate power values in MBAR is described in the program description using the formulas discussed in sections 3.1 and 3.2. The procedures used to generate power values in RPOW are described below.

A.2. Monte Carlo Power Values

Effect Size

In RPOW a design with a given effect size was created by setting the means of two treatments at D and -D with all other treatment means (if there are any) set at zero. Here

$$D = \frac{ES\sqrt{2L}}{2} \text{ where}$$

ES = the desired effect size and L = the number of levels. This type of design is discussed by Cohen (1977, p. 277).

Correlated Observations

To create scores with a specified correlation between them a correlation matrix R was created where the off diagonal elements were all set equal to a desired correlation. This matrix was then factor into upper and lower triangular matrices L and L' using the Cholesky (square root factoring) decomposition of R, i.e. R = L L'. A score for each entity in a group was arrived at using a procedure described by Collier, Baker, Mandeville and Hayes (1967, pp. 343-344) where a vector of scores, $\underline{z}$, was generated that were independently and normally distributed with a mean of zero and a standard deviation of one; the desired vector of scores $\underline{x}$ was found from $\underline{x} = L\underline{z}$.

Power Values

The preceding procedure was used to generate correlated scores for entities within independent groups. For a specified number of treatment levels and groups per treatment level, an ANOVA was carried out and the decision recorded as to whether or not the null hypothesis of no treatment effects was rejected. This process was then repeated 1000 times where the number of times the null hypothesis was rejected was divided by 1000 to indicate the power of the F-test for a given set of parameters.

TABLE 4.5.36

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.41	0.69	0.85	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.41	0.70	0.86	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.42	0.70	0.86	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.42	0.70	0.86	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.42	0.71	0.87	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.43	0.71	0.87	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.43	0.71	0.87	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.43	0.72	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.43	0.72	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.44	0.73	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.44	0.73	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.44	0.73	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.44	0.73	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.44	0.73	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

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C-----------------------------------------------------------------------RPOW0001
C  PROGRAM RPOW WAS WRITTEN BY ROBERT S. BARCIKOWSKI                    RPOW0002
C  AT OHIO UNIVERSITY                                                   RPOW0003
C  FUNDING FOR RPOW WAS PROVIDED BY THE NATIONAL INSTITUTE OF EDUCATION.RPOW0004
C  GRANT NUMBER:  NIE-G-78-0072                                         RPOW0005
C  GRANT TITLE:  STATISTICAL POWER WITH GROUP                           RPOW0006
C                MEAN AS THE UNIT OF ANALYSIS                           RPOW0007
C  FUNDING PERIOD:  1978 - 1980                                         RPOW0008
C-----------------------------------------------------------------------RPOW0009
C  RPOW IS A MONTE CARLO PROGRAM THAT COMPUTES POWER VALUES             RPOW0010
C  FOR A ONE-WAY ANALYSIS OF VARIANCE WHEN GROUP MEAN IS THE            RPOW0011
C  UNIT OF ANALYSIS. AND THERE IS A CORRELATION AMONG THE               RPOW0012
C  ENTITIES IN A UNIT.                                                  RPOW0013
C-----------------------------------------------------------------------RPOW0014
C-----------------------------------------------------------------------RPOW0015
C  CARD 1                                                               RPOW0016
C-----------------------------------------------------------------------RPOW0017
C     COLUMNS                                                           RPOW0018
C      1 - 80      ANY LABEL                                            RPOW0019
C-----------------------------------------------------------------------RPOW0020
C  CARD 2                                                               RPOW0021
C-----------------------------------------------------------------------RPOW0022
C     COLUMNS                                                           RPOW0023
C      1 - 80      ANY LABEL                                            RPOW0024
C-----------------------------------------------------------------------RPOW0025
C  CARD 3                                                               RPOW0026
C-----------------------------------------------------------------------RPOW0027
C     COLUMNS                                                           RPOW0028
C      1 - 9       ISEED = SEED VALUE FOR THE RANDOM NUMBER             RPOW0029
C                  GENERATOR (ODD NUMBER)                               RPOW0030
C                                                                       RPOW0031
C     10 - 13      ISUB = NUMBER OF ENTITY SIZES TO BE READ             RPOW0032
C                  (20 MAXIMUM)                                         RPOW0033
C                                                                       RPOW0034
C     14 - 17      LEVEL1 = INITIAL NUMBER OF TREATMENT LEVELS          RPOW0035
C                  (GREATER THEN ONE)                                   RPOW0036
C                                                                       RPOW0037
C     18 - 21      LEVEL2 = TERMINAL NUMBER OF TREATMENT LEVELS         RPOW0038
C                                                                       RPOW0039
C     22 - 25      IREP = NUMBER OF REPLICATIONS FOR EACH POWER VALUE   RPOW0040
C                                                                       RPOW0041
C     26 - 29      ISUBR = NUMBER SENT TO SUBROUTINE CORR               RPOW0042
C                  THAT INDICATES WHETHER THE CORRELATION               RPOW0043
C                  MATRICES ARE TO BE READ IN OR CREATED :              RPOW0044
C                  1 = READ. 2 = CREATED.                               RPOW0045
C                  SEE SUBROUTINE CORR FOR CARDS WHEN ISUBR = 1.        RPOW0046
C                                                                       RPOW0047
C     30 - 33      ICORR = NUMBER OF OFF DIAGONAL CORRELATIONS IF       RPOW0048
C                  ISUBR = 2.  (20 MAXIMUM)                             RPOW0049
C                  ICORR = NUMBER OF CORRELATION MATRICES TO BE READ    RPOW0050
C                  IF ISUBR = 1.  (NO LIMIT)                            RPOW0051
C                                                                       RPOW0052
C     34 - 37      IES = NUMBER OF EFFECT SIZES READ (20 MAXIMUM).      RPOW0053
C-----------------------------------------------------------------------RPOW0054
C  CARD 4                                                               RPOW0055
C-----------------------------------------------------------------------RPOW0056
C     COLUMNS                                                           RPOW0057
C      1 - 4       NUMBER OF ENTITIES PER TREATMENT -- READ BY (2014)   RPOW0058
C                  *** IMPORTANT *** THE LARGEST NUMBER OF ENTITIES     RPOW0059
C                  MUST BE ORDERED LAST                                 RPOW0060
```

```
C        5 - 8
C        ETC.
C       77 - 80
C-----------------------------------------------------------------------
C CARD 5    (THIS CARD WOULD BE SKIPPED IF ISUBR = 1)
C-----------------------------------------------------------------------
C       COLUMNS
C        1 - 4          CORRELATION VALUES FOR CREATED MATRICES
C                       -- READ BY (20F4.0)
C        5 - 8
C        ETC.
C       77 - 80
C-----------------------------------------------------------------------
C  CARD 6
C-----------------------------------------------------------------------
C       COLUMNS
C        1 - 4          EFFECT SIZE -- READ BY (20F4.0)
C        5 - 8
C        ETC.
C       77 - 80
C-----------------------------------------------------------------------
C  CARD 7
C-----------------------------------------------------------------------
C        1 - 4          TABLE IDENTIFICATION NUMBER -- READ BY (20A4)
C                       ICORR * ISUB = NUMBER OF TABLES
C        5 - 8
C        ETC.
C       77 - 80
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C  LIMITATIONS:
C-----------------------------------------------------------------------
C  PROGRAM RPOW IS DIMENSIONED FOR A MAXIMUM OF 100 ENTITIES PER GROUP;
C  THE NUMBER OF GROUPS IS SET IN A DATA STATEMENT AT 20, 10, 5, 2.
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      DIMENSION WTV(5),S(3),NDF(3),NGROUP(5),Z(100),Y(100),NOGP(5),
     >  TM(5),LABEL(40),NSUB(20),R(20),ES(20),XBAR(5),POW1(5),POW2(5),
     >  POW3(5),ESCAL(5),ITABLE(42)
      COMMON /SUB1/ISUBR,A(100,100),TRIA(100,100),COR,NSG
      DATA NGROUP/20,10,5,2/
C
C  THE FOLLOWING PROGRAM STATEMENTS READ AND PRINT THE INITIAL PROGRAM
C  PARAMETERS DESCRIBED ABOVE FOR CARD INPUT
C
      READ 1,LABEL
    1 FORMAT(20A4)
      PRINT 2,LABEL
    2 FORMAT(1H1,(20A4))
      READ 3,ISEED,ISUB,LEVEL1,LEVEL2,IREP,ISUBR,ICORR,IES
    3 FORMAT(I9,7I4)
      PRINT 4,ISEED,ISUB,LEVEL1,LEVEL2,IREP,ISUBR,ICORR,IES
    4 FORMAT(1H0,'THE SEED VALUE IS',I15,//,' NUMBER OF DIFFERENT ',
     >  'SAMPLE SIZES',I5//,' INITIAL NUMBER OF LEVELS',I5,//,
     >  ' TERMINAL NUMBER OF LEVELS',I5//,' NUMBER OF REPLICATIONS',I6,/
     >  /' SUBROUTINE VALUE IS',I3,10X,'* 1 = READ, 2 = CREATE *',//,
     >  ' NUMBER OF CORRELATIONAL VALUES',I3,//,' NUMBER OF EFFECT ',
     >  'SIZES',I3)
      CALL INTGEN(ISEED)
      READ 5,(NSUB(I),I=1,ISUB)
    5 FORMAT(20I4)
      PRINT 6,(NSUB(I),I=1,ISUB)
    6 FORMAT('0CELL SAMPLE SIZES',/(20I6))
      IF(ISUBR.EQ.1) GO TO 9
      READ 7,(R(I),I=1,ICORR)
    7 FORMAT(20F4.0)
      PRINT 8,(R(I),I=1,ICORR)
    8 FORMAT('0CORRELATIONS FOR CREATED MATRICES',/(20F6.2))
    9 READ 7,(ES(I),I=1,IES)
      PRINT 10,(ES(I),I=1,IES)
   10 FORMAT('0EFFECT SIZES',/(20F6.3))
C
C   A POWER TABLE IS PRODUCED FOR EACH SAMPLE SIZE AND EACH CORRELATION
C   AMONG THE ENTITIES IN A UNIT. THEREFORE, THE NUMBER OF TABLES
C   (NTAB) WILL EQUAL THE NUMBER OF CORRELATIONS (ICORR) TIMES THE
C   NUMBER OF THE DIFFERENT SAMPLE SIZES (ISUB)
C
      NTAB = ICORR*ISUB
      READ 1,(ITABLE(I),I=1,NTAB)
      PRINT 11,(ITABLE(I),I=1,NTAB)
   11 FORMAT('0THE TABLES TO BE PRINTED ARE :',20A4)
C
C   ITAB IS A COUNTER THAT SERVES AS THE SUBSCRIPT OF ITABLE, I.E.,
C   IT SERVES AS THE TABLE NUMBER IDENTIFIER.
C
      ITAB = 0
C
C   THE THREE DO 29 LOOPS ESTABLISH IN ORDER:  1. THE CORRELATION
C   AMONG THE ENTITIES, 2. ALL SAMPLE SIZES, AND 3. THE NUMBER OF UNITS
C   PER CELL.  A COMPLETE TABLE IS PRINTED EACH TIME THE THIRD 'DO 29'
C   IS EXHAUSTED.
C
      DO 29 J=1,ICORR
      COR = R(J)
      NSG = NSUB(ISUB)/2
C
C   THE CHOLESKY DECOMPOSITION OF THE CORRELATION MATRIX DONE IN SUBROU-
C   TINE CORR IS EXECUTED FOR THE MAXIMUM SAMPLE SIZE. THE RESULTANT
C   TRIANGULAR MATRIX IS THEN PARTITIONED ACCORDING TO UNIT SIZE. THIS
C   IS POSSIBLE BECAUSE THE CORRELATIONS AMONG THE ENTITIES ARE FIXED.
C
C
C   A CORRELATION MATRIX (A) IS CREATED BASED ON THE LARGEST SAMPLE
C   SIZE.  IN CORR THE TRIANGULAR MATRIX T (TRIA) IS FORMED SUCH
C   THAT A = TT'.  SUB-MATRICES OF A AND T ARE THEN USED WITH
C   SMALLER SAMPLE SIZES.
C
      CALL CORR
C
      DO 29 I=1,ISUB
      N = NSUB(I)
      RN = N
C-----------------------------------------------------------------------
C   PRINT STATEMENTS THAT WERE MADE INTO COMMENT STATEMENTS MAY
C   BE USED, BY DELETING THE C IN THE FIRST COLUMN, TO CHECK
C   ON THE CALCULATIONS IN THIS PROGRAM.
C
C     PRINT 1000,N,I,ISUB,RN
C1000 FORMAT(3I7,F8.4)
C-----------------------------------------------------------------------
```

```
      ITAB = ITAB+1                                                     RPOW0181
C     PRINT 1001,COR,I,J,ITAB,ICORR                                     RPOW0182
C1001 FORMAT(2X,F8.4,4I3)                                               RPOW0183
      PRINT 12,ITABLE(ITAB),COR,N,IREP                                  RPOW0184
   12 FORMAT(1H1,////,T57,'TABLE',A4/,1H0,T33,'ESTIMATED POWER WHEN ',   RPOW0185
     >  'GROUP MEAN IS THE UNIT OF ANALYSIS AND'/,1H0,T38,'THE ',       RPOW0186
     >  'CORRELATION BETWEEN THE UNIT MEMBERS IS',F5.2,':'/,1H0,T41,    RPOW0187
     >  'BASED ON',I5,' ENTITIES AND',I5,' REPLICATIONS')               RPOW0188
      PRINT 13                                                          RPOW0189
   13 FORMAT(1H0,21('-------'))                                         RPOW0190
      PRINT 14                                                          RPOW0191
   14 FORMAT(1H0,'UNITS',T9,'UNIT',T16,'EFFECT SIZE',T30,'2 LEVELS / ', RPOW0192
     >  'ALPHA',T48,'EFFECT',T56,'3 LEVELS / ALPHA',T74,'EFFECT',T82,   RPOW0193
     >  '4 LEVELS / ALPHA',T100,'EFFECT',T108,'5 LEVELS / ALPHA'/,T9,   RPOW0194
     >  'SIZE',T15,'ENT UNIT  EST',T32,'.01  .05  .10',T49,'SIZE',T58,  RPOW0195
     >  '.01  .05  .10',T75,'SIZE',T84,'.01  .05  .10',T101,'SIZE',T110,RPOW0196
     >  '.01  .05  .10')                                                RPOW0197
      PRINT 13                                                          RPOW0198
      DO 29 M=1,4                                                       RPOW0199
      NG = NGROUP(M)                                                    RPOW0200
      RNG = NG                                                          RPOW0201
      NSG = N/NG                                                        RPOW0202
      RNSG = NSG                                                        RPOW0203
C     PRINT 1002,M,NG, NGROUP(M),NSG,RNG,RNSG                           RPOW0204
C1002 FORMAT(4I7,2F8.2)                                                 RPOW0205
      DO 28 K=1,IES                                                     RPOW0206
      RES = ES(K)                                                       RPOW0207
      ENTES = RES                                                       RPOW0208
C                                                                       RPOW0209
C  WHEN A UNIT COMPOSED OF N (RNSG) ENTITIES IS USED AS THE UNIT OF     RPOW0210
C  ANALYSIS THE EFFECT SIZE (UNITES) BASED ON A UNIT IS FOUND           RPOW0211
C  USING THE NEXT TWO STATEMENTS.                                       RPOW0212
C                                                                       RPOW0213
      UN = 1.0+(RNSG-1.0)*COR                                           RPOW0214
      UNITES = SQRT(RNSG/UN)*RES                                        RPOW0215
C     PRINT 1003,K,IES,RES,ENTES,UNITES                                 RPOW0216
C1003 FORMAT(2I7,3F8.3)                                                 RPOW0217
      DO 26 L=LEVEL1,LEVEL2                                             RPOW0218
      RL = L                                                            RPOW0219
      D = RES*SQRT(2.0*RL)*.5                                           RPOW0220
C                                                                       RPOW0221
C  IN THIS SECTION THE MEANS (XBAR(LH)) OF THE FIRST AND LAST TREATMENT RPOW0222
C  LEVELS ARE SET AT D AND -D; ALL MEANS BETWEEN THESE TWO MEANS ARE    RPOW0223
C  SET AT ZERO. COHEN (1977, P 277) INDICATES THAT EFFECT SIZE (RES)=   RPOW0224
C  SQRT(D**2/(2*RL)). HERE D IS FOUND GIVEN EFFECT SIZE (RES) AND       RPOW0225
C  NUMBER OF LEVELS (RL).                                               RPOW0226
C                                                                       RPOW0227
      DO 15 LH=1,L                                                      RPOW0228
      XBAR(LH) = 0.0                                                    RPOW0229
      NOGP(LH) = NG                                                     RPOW0230
   15 CONTINUE                                                          RPOW0231
      XBAR(1) = -D                                                      RPOW0232
      XBAR(L) = D                                                       RPOW0233
C                                                                       RPOW0234
C  D1=BETWEEN TREATMENTS DEGREES OF FREEDOM                             RPOW0235
C  D2=ERROR DEGREES OF FREEDOM                                          RPOW0236
C                                                                       RPOW0237
      D1 = RL-1.0                                                       RPOW0238
      D2 = RL*(RNG-1.)                                                  RPOW0239
C                                                                       RPOW0240
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```
C   ESCAL(L)=CALCULATED EFFECT SIZE FOR L LEVELS
C
       ESCAL(L) = 0.0
C
C   POW1(L)=POWER FOR L LEVELS WHEN ALPHA EQUALS .01
C   POW2(L)=POWER FOR L LEVELS WHEN ALPHA EQUALS .05
C   POW3(L)=POWER FOR L LEVELS WHEN ALPHA EQUALS .10
C
       POW1(L) = 0.0
       POW2(L) = 0.0
       POW3(L) = 0.0
C
C   SUBROUTINE MDFI IS AN IMSL SUBROUTINE THAT RETURNS AN F VALUE (REJ1.
C   REJ2. REJ3) THAT CORRESPONDS TO EACH OF THE ABOVE ALPHA LEVELS.
C
       CALL MDFI(.99.D1.D2.REJ1.IER)
       CALL MDFI(.95.D1.D2.REJ2.IER)
       CALL MDFI(.90.D1.D2.REJ3.IER)
C      PRINT 1004. L.D.XBAR.D1.D2.POW1(L).POW2(L).POW3(L).REJ1.REJ2.REJ3
C     <.D1,D2.IER
C1004 FORMAT(I5.16F7.2.I5)
C
C   'DO 25' LOOPS OVER THE DESIRED NUMBER OF RELICATIONS (IREP)
C
       DO 25 N1=1.IREP
       REP = IREP
       JM = 0
C
C   THE 'DO 18' ESTABLISH ONE ANOVA WITH NG UNITS PER CELL.
C
       DO 18 J1=1.L
       DO 18 J2=1.NG
       JM = JM+1
       Y(JM) = 0.0
C      PRINT 1005.J1.J2.JM.XBAR(J1)
C1005 FORMAT(3I5.(10F8.4))
C
C   A SCORE FOR EACH ENTITY IN A GROUP IS ARRIVED AT USING A PROCEDURE
C   DESCRIBED BY COLLIER. BAKER. MANDELVILLE AND HAYES (1967. PP 343-344)
C   HERE ANORM(T) AND THEREFORE Z(I1) IS A SCORE WHICH IS APPROXIMATELY
C   INDEPENDENTLY AND NORMALLY DISTRIBUTED WITH MEAN ZERO AND STANDARD
C   DEVIATION OF ONE. ANORM IS AN OHIO UNIVERSITY LIBRARY FUNCTION.
C
       SUM = 0.0
C
C   DO LOOPS 17 AND 16 CREATE A VECTOR OF SCORES (X) WHICH ARE
C   CORRELATED ACCORDING TO THE CORRELATIONS THAT WERE READ IN. THE
C   MATRIX FORMULA  USED IS ; X=LZ WHERE L IS A LOWER TRIANGLAR MATRIX
C   FOUND BY FACTORING THE CORRELATION MATRIX LL' AND Z(I1) IS DESCRIBED
C   ABOVE.
C
       DO 17 I1=1.NSG
       Z(I1) = ANORM(T)
       X = 0.0
       DO 16 L1=1.I1
C
C   IN LOOPS 17 AND 16 THE CONVERTED SCORES ARE CREATED AND
C   APPROPRIATE MEAN DIFFERENCES ARE ESTABLISHED FOR THE TREATMENT
C   LEVELS. THE PROCESS DESCRIBED FOR A GROUP OF TWO SUBJECTS IN THE
C   FIRST TREATMENT LEVEL LOOKS AS FOLLOWS;
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```
C   X(1)= D+TRIA(11)*Z(1)
C   X(2)=D+TRIA(21)*Z(1)+TRIA(22)*Z(2)
C
      X = X+TRIA(I1.L1)*Z(L1)
C     PRINT 1006.X     .TRIA(I1.L1).Z(L1).L1.I1
C1006 FORMAT(3F8.4.2I5)
   16 CONTINUE
      SUM = SUM+X
   17 CONTINUE
      Y(JM) = SUM/RNSG+XBAR(J1)
C     PRINT 1007.Y(JM).SUM.RNG.JM
C1007 FORMAT(3F8.4.I5)
   18 CONTINUE
C
C   IMSL SUBROUTINE ACRDAN CALCULATES A ONE-WAY ANALYSIS OF VARIANCE.
C   GIVEN THE SCORES IN A TREATMENT (HERE EACH GROUP'S SCORE) STORED IN
C   THE VECTOR Y. THE NUMBER OF THE LEVELS. L. AND THE NUMBER OF
C   SUBJECTS IN EACH TREATMENT STORED IN THE VECTOR NOGP. THE
C   SUBROUTINE RETURNS THE TREATMENT MEAN STORED IN THE VECTOR TM. THE
C   THE TREATMENT AND ERROR SUMS OF SQUARES STORED IN THE VECTOR S. THE
C   GRAND MEAN GM. AND THE DEGREES OF FREEDOM FOR TREATMENTS AND ERROR
C   IN THE VECTOR NDF. THE VECTOR WTV IS A WORK VECTOR AND IER IS AN
C   IMSL ERROR CODE.
C
      CALL ACRDAN(Y.L.NOGP.TM.WTV.S.GM.NDF.IER)
C     PRINT 1005.NDF.(Y(KK).KK=1.JM).S.GM.TM
      DF1 = NDF(1)
      DF2 = NDF(2)
      ERRT = S(2)/DF2
C
C   FCAL IS THE CALCULATED F STATISTIC.
C
      FCAL = (S(1)/DF1)/ERRT
      SM = 0.0
C
C   SM IS THE SUM OF TREATMENT EFFECTS SQUARED AND DIVIDED BY THE
C   TREATMENT LEVELS.
C
      DO 19 L2=1.L
      SM = (TM(L2)-GM)**2+SM
   19 CONTINUE
      SM = SQRT(SM/RL)
      ERRT = SQRT(ERRT)
      ESCAL(L) = SM/ERRT+ESCAL(L)
C     IF(L.EQ.5)  PRINT 1010.(TM(IX).IX=1.2).GM.SM.ERRT.L.ESCAL(L)
C1010 FORMAT('0TM(1) = '.F8.3.'   TM(2) = '.F8.3.'   GM = '.F8.3.
C    <  '    SM = '.F8.3.
C    <  '    ERRT = '.F8.3.'   ESCAL('.I1.') = '.F8.3)
C
C   IF THE TABLED F VALUE (REJ1) IS LESS THAN OR EQUAL TO THE
C   CALCULATED F VALUE (FCAL) THE POWER CUUNTERS
C   (POW1(L).POW2(L).POW3(L)) ARE
C   INCREMENTED BY ONE. IF F IS SIGNIFICANT AT .01 THEN IT WILL ALSO BE
C   SIGNIFICANT AT .05 AND .10. THEREFORE. THE COUNTERS FOLLOWING
C   STATEMENT  20 ARE ALL INCREMENTAL. THE PROCESS IS REPEATED IN
C   STATEMENTS 21  AND 23  FOR ALPHA EQUAL .05 AND .10 RESPECTIVELY.
C
      IF(REJ1-FCAL) 20.20.21
   20 POW1(L) = POW1(L)+1.0
      POW2(L) = POW2(L)+1.0
      POW3(L) = POW3(L)+1.0                                             RPOW0361
      GO TO 25                                                          RPOW0362
   21 IF(REJ2-FCAL) 22.22.23                                            RPOW0363
   22 POW2(L) = POW2(L)+1.0                                             RPOW0364
      POW3(L) = POW3(L)+1.0                                             RPOW0365
      GO TO 25                                                          RPOW0366
   23 IF(REJ3-FCAL) 24.24.25                                            RPOW0367
   24 POW3(L) = POW3(L)+1.0                                             RPOW0368
   25 CONTINUE                                                          RPOW0369
C  *****  THE PRECEDING CARD MUST BE REMOVED FOR THE FOLLOWING PRINT.   RPOW0370
C25   PRINT 1008.L.POW1(L).POW2(L).POW3(L).FCAL.REJ1.REJ2.REJ3          RPOW0371
C1008 FORMAT(I5.7F8.3)                                                  RPOW0372
C                                                                       RPOW0373
C  ESCAL (L) WHEN DEVIDED BY REP BELOW IS THE ESTIMATED (MEAN) EFFECT   RPOW0374
C  SIZE FOR AN ANOVA WITH L LEVELS.                                     RPOW0375
C                                                                       RPOW0376
      ESCAL(L) = ESCAL(L)/REP                                           RPOW0377
C                                                                       RPOW0378
C  THE EFFECT SIZE SUM AND THE POWER COUNTERS ARE ALL DIVIDED BY THE    RPOW0379
C  NUMBER OF THE REPLICATIONS (REP - USUALLY SET AT 1000!.              RPOW0380
C                                                                       RPOW0381
      POW1(L) = POW1(L)/REP                                             RPOW0382
      POW2(L) = POW2(L)/REP                                             RPOW0383
      POW3(L) = POW3(L)/REP                                             RPOW0384
   26 CONTINUE                                                          RPOW0385
C                                                                       RPOW0386
C  A LINE OF POWER VALUES IS PRINTED FOR A GIVEN EFFECT SIZE ACROSS     RPOW0387
C  ALL  LEVELS.                                                         RPOW0388
C                                                                       RPOW0389
      PRINT 27.NG.NSG.ENTES.UNITES.(ESCAL(L).POW1(L).POW2(L).POW3(L).   RPOW0390
     >  L=LEVEL1.LEVEL2)                                                RPOW0391
   27 FORMAT(1H0.I4.T9.I3.T14.2(F4.2.'/').F5.2.T30.3F5.2.T48.F6.2.T56.  RPOW0392
     >  3F5.2.T74.F6.2.T82.3F5.2.T100.F6.2.T108.3F5.2)                  RPOW0393
   28 CONTINUE                                                          RPOW0394
      PRINT 13                                                          RPOW0395
   29 CONTINUE                                                          RPOW0396
      STOP                                                              RPOW0397
      END                                                               RPOW0398
      SUBROUTINE CORR                                                   RPOW0001
      COMMON /SUB1/ISUB.A(100.100).TRIA(100.100).COR.NV                 RPOW0002
      DIMENSION VFMT(20)                                                RPOW0003
      GO TO (1.4).ISUB                                                  RPOW0004
C-----------------------------------------------------------------------RPOW0005
C  IF ISUBR = 1 IN THE MAIN PROGRAM. THEN. FOLLOWING THE LAST           RPOW0006
C  TABLE NUMBERS CARD SHOULD BE:                                        RPOW0007
C  1)  A FORMAT CARD FOR THE CORRELATION MATRIX TO BE READ IN           RPOW0008
C  2) THE CORRELATION MATRIX TO BE READ BY THE PRECEDING FORMAT CARD    RPOW0009
    1 READ 2.VFMT                                                       RPOW0010
    2 FORMAT(20A4)                                                      RPOW0011
      DO 3 I=1.NV                                                       RPOW0012
      READ VFMT.(A(I.J).J=1.NV)                                         RPOW0013
    3 CONTINUE                                                          RPOW0014
C-----------------------------------------------------------------------RPOW0015
      GO TO 7                                                           RPOW0016
    4 DO 6 I=1.NV                                                       RPOW0017
      DO 5 J=1.NV                                                       RPOW0018
    5 A(I.J) = COR                                                      RPOW0019
      A(I.I) = 1.0                                                      RPOW0020
    6 CONTINUE                                                          RPOW0021
    7 CONTINUE                                                          RPOW0022
```

```
C                                                                       RPOW0023
C   A IS THE POPULATION CORRELATION MATRIX                              RPOW0024
C                                                                       RPOW0025
C     PRINT 17                                                          RPOW0026
C  17 FORMAT('0THE POPULATION CORRELATICN MATRIX'/)                     RPOW0027
C     DO 6 I = 1,NV                                                     RPOW0028
C   6 PRINT 18,(A(I,J),J=1,NV)                                          RPOW0029
C  18 FORMAT(12F10.6/12F10.6/)                                          RPOW0030
C-----------------------------------------------------------------------RPOW0031
C   CHOLESKY (SQUARE ROOT FACTORING) DECOMPOSITION OF THE               RPOW0032
C   POPULATION CORRELATION MATRIX.  SEE FINN, J.D. A GENERAL            RPOW0033
C   MODEL FOR MULTIVARIATE ANALYSIS.  NEW YORK:  HOLT, RINEHART         RPOW0034
C   AND WINSTON, 1974, PP. 37 - 39.                                     RPOW0035
C-----------------------------------------------------------------------RPOW0036
      DO 8 J=1,NV                                                       RPOW0037
      DO 8 I=1,NV                                                       RPOW0038
      TRIA(I,J) = 0.0                                                   RPOW0039
    8 CONTINUE                                                          RPOW0040
      TRIA(1,1) = A(1,1)**.5                                            RPOW0041
      DO 9 I=2,NV                                                       RPOW0042
      TRIA(I,1) = A(I,1)/TRIA(1,1)                                      RPOW0043
    9 CONTINUE                                                          RPOW0044
      DO 13 J=2,NV                                                      RPOW0045
      TSQ = 0.0                                                         RPOW0046
      JJ = J-1                                                          RPOW0047
      DO 10 K=1,JJ                                                      RPOW0048
      TSQ = TSQ+TRIA(J,K)*TRIA(J,K)                                     RPOW0049
   10 CONTINUE                                                          RPOW0050
      TRIA(J,J) = (A(J,J)-TSQ)**.5                                      RPOW0051
      X = TRIA(J,J)                                                     RPOW0052
      IIJ = J+1                                                         RPOW0053
      IF(IIJ.GT.NV) GO TO 13                                            RPOW0054
      DO 12 I1=IIJ,NV                                                   RPOW0055
      TJKTJK = 0.0                                                      RPOW0056
      DO 11 KK=1,JJ                                                     RPOW0057
      TJKTJK = TJKTJK+TRIA(I1,KK)*TRIA(J,KK)                            RPOW0058
   11 CONTINUE                                                          RPOW0059
      TRIA(I1,J) = (A(I1,J)-TJKTJK)/X                                   RPOW0060
   12 CONTINUE                                                          RPOW0061
   13 CONTINUE                                                          RPOW0062
C     DO 27 I = 1,NV                                                    RPOW0063
C27   PRINT 18,(TRIA(I,J),J=1,I)                                        RPOW0064
      RETURN                                                            RPOW0065
      END                                                               RPOW0066
```

```
*
EXECUTION TIME FOR RPOW ON AN IBM 370 WAS 32 MIN. 2.36 SEC
```

```
  THE FOLLOWING CARD INPUT GENERATED THE PROGRAM OUTPUT ON THE
  FOLLOWING PAGE AND TABLE 4.2.1
*
  THE FIRST AND LAST TWO CARDS SERVE TO IDENTIFY COLUMNS AND
  ARE NOT PART OF THE CARD INPUT
*

12345678901234567890123456789012345678901234567890123456789012345678901234567890
00000000011111111112222222222333333333344444444445555555555666666666677777777778

  FINAL RUN
  WHITE PAPER
141577111   1   2   51000   2   1   3
  40
 .20
 .10 .25 .40

00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

The single table identification card was left blank so that the table could be numbered on a typewriter.

```
C   PROGRAM MBAR WAS WRITTEN BY ROBERT S. BARCIKOWSKI                   MBAR0001
C   AT OHIO UNIVERSITY                                                   MBAR0002
C   FUNDING FOR MBAR WAS PROVIDED BY THE NATIONAL INSTITUTE OF EDUCATION.MBAR0003
C   GRANT NUMBER:  NIE-G-78-0072                                         MBAR0004
C-----------------------------------------------------------------------MBAR0005
C   GRANT TITLE:  STATISTICAL POWER WITH GROUP                           MBAR0006
C                 MEAN AS THE UNIT OF ANALYSIS                           MBAR0007
C   FUNDING PERIOD:  1978 - 1980                                         MBAR0008
C-----------------------------------------------------------------------MBAR0009
C   MBAR COMPUTES POWER VALUES MATHEMATICALLY FOR ONE WAY ANALYSIS OF    MBAR0010
C   VARIANCE WHEN EACH UNIT IS MADE UP OF N ENTITIES                     MBAR0011
C   AND THE ENTITIES HAVE A CONSTANT CORRELATION, R, BETWEEN THEM.       MBAR0012
C                                                                        MBAR0013
C   MBAR WAS WRITTEN SO THAT THE TOTAL NUMBER OF ENTITIES (SUBJECTS)     MBAR0014
C   PER TREATMENT LEVEL REMAINS CONSTANT WHILE GROUP SIZE VARIES.        MBAR0015
C-----------------------------------------------------------------------MBAR0016
C-----------------------------------------------------------------------MBAR0017
C   CARD 1                                                               MBAR0018
C-----------------------------------------------------------------------MBAR0019
C       COLUMNS                                                          MBAR0020
C         1 - 80        ANY LABEL                                        MBAR0021
C-----------------------------------------------------------------------MBAR0022
C   CARD 2                                                               MBAR0023
C-----------------------------------------------------------------------MBAR0024
C       COLUMNS                                                          MBAR0025
C         1 - 80        ANY LABEL                                        MBAR0026
C-----------------------------------------------------------------------MBAR0027
C   CARD 3                                                               MBAR0028
C-----------------------------------------------------------------------MBAR0029
C       COLUMNS                                                          MBAR0030
C         1 - 4         ISUB = NUMBER OF SUBJECT SIZES TO BE READ        MBAR0031
C                       (20 MAXIMUM)                                     MBAR0032
C                                                                        MBAR0033
C         5 - 8         LEVEL1 = INITIAL NUMBER OF TREATMENT LEVELS      MBAR0034
C                       (GREATER THEN ONE)                               MBAR0035
C                                                                        MBAR0036
C         7 - 12        LEVEL2 = TERMINAL NUMBER OF TREATMENT LEVELS     MBAR0037
C                       ONLY FOUR DIFFERENT LEVEL SIZES CAN BE PRINTED   MBAR0038
C                       AT ONE TIME; THEREFORE, LEVEL2 - LEVEL1          MBAR0039
C                       SHOULD NOT EXCEED THREE.                         MBAR0040
C                                                                        MBAR0041
C        13 - 16        ICORR = NUMBER OF OFF DIAGONAL CORRELATIONS IF   MBAR0042
C                       ISUBR = 2.  (20 MAXIMUM)                         MBAR0043
C                                                                        MBAR0044
C        17 - 20        IES = NUMBER OF EFFECT SIZES READ (20 MAXIMUM).  MBAR0045
C-----------------------------------------------------------------------MBAR0046
C   CARD 4                                                               MBAR0047
C-----------------------------------------------------------------------MBAR0048
C       COLUMNS                                                          MBAR0049
C         1 - 4         NUMBER OF ENTITIES PER TREATMENT -- READ BY (20I4)   MBAR0050
C         5 - 8                                                          MBAR0051
C        77 - 80                                                         MBAR0052
C-----------------------------------------------------------------------MBAR0053
C CARD 5                                                                 MBAR0054
C-----------------------------------------------------------------------MBAR0055
C       COLUMNS                                                          MBAR0056
C         1 - 4         CORRELATION VALUES                               MBAR0057
C                       -- READ BY (20F4.0)                              MBAR0058
C         5 - 8                                                          MBAR0059
C        ETC.                                                            MBAR0060
```

```
C     77 - 80                                                           MBAR0061
C-----------------------------------------------------------------------MBAR0062
C  CARD 6                                                               MBAR0063
C-----------------------------------------------------------------------MBAR0064
C     COLUMNS                                                           MBAR0065
C      1 - 4       EFFECT SIZE -- READ BY (20F4.0)                      MBAR0066
C      5 - 8                                                            MBAR0067
C      ETC.                                                             MBAR0068
C     77 - 80                                                           MBAR0069
C-----------------------------------------------------------------------MBAR0070
C  CARD 7                                                               MBAR0071
C-----------------------------------------------------------------------MBAR0072
C     COLUMNS                                                           MBAR0073
C      1 - 4       TABLE IDENTIFICATION NUMBER -- READ BY (20A4)        MBAR0074
C                  MAXIMUM NUMBER OF TABLES IS 200.                     MBAR0075
C                  THE NUMBER OF TABLES TO BE PRINTED IS EQUAL TO       MBAR0076
C                  ISUB * ICORR.                                        MBAR0077
C      5 - 8                                                            MBAR0078
C      ETC.                                                             MBAR0079
C     77 - 80                                                           MBAR0080
C-----------------------------------------------------------------------MBAR0081
C-----------------------------------------------------------------------MBAR0082
C  LIMITATIONS:                                                         MBAR0083
C-----------------------------------------------------------------------MBAR0084
C  THE NUMBER OF GROUPS IS SET IN A DATA STATEMENT AT 20, 10, 5, 2.     MBAR0085
C-----------------------------------------------------------------------MBAR0086
C-----------------------------------------------------------------------MBAR0087
      DIMENSION NSUB(20),R(20),ES(20),NOGP(5),LABEL(40),POW1(5),POW2(5),MBAR0088
     >  POW3(5),ITABLE(200),NGROUP(4)                                   MBAR0089
      DOUBLE PRECISION RLAM,D1,D2,FA,ZPOW,FPR                           MBAR0090
C-----------------------------------------------------------------------MBAR0091
C  THE FOLLOWING PROGRAM STATEMENTS READ AND PRINT THE INITIAL PROGRAM  MBAR0092
C  PARAMETERS DESCRIBED ABOVE FOR CARD INPUT                            MBAR0093
C-----------------------------------------------------------------------MBAR0094
      DATA NGROUP/20,10,5,2/                                            MBAR0095
      READ 1,LABEL                                                      MBAR0096
    1 FORMAT(20A4)                                                      MBAR0097
      PRINT 2,LABEL                                                     MBAR0098
    2 FORMAT(1H1,(20A4))                                                MBAR0099
      READ 3,ISUB,LEVEL1,LEVEL2,ICORR,IES                               MBAR0100
    3 FORMAT(5I4)                                                       MBAR0101
      PRINT 4,ISUB,LEVEL1,LEVEL2,ICORR,IES                              MBAR0102
    4 FORMAT(1H0,' NUMBER OF DIFFERENT SAMPLE SIZES',I5//,' INITIAL ',  MBAR0103
     >  'NUMBER OF LEVELS',I5,//,' TERMINAL NUMBER OF LEVELS',I5//,     MBAR0104
     >  ' NUMBER OF CORRELATIONAL VALUES',I3,//,' NUMBER OF EFFECT ',   MBAR0105
     >  'SIZES',I3)                                                     MBAR0106
      READ 5,(NSUB(I),I=1,ISUB)                                         MBAR0107
    5 FORMAT(20I4)                                                      MBAR0108
      PRINT 6,(NSUB(I),I=1,ISUB)                                        MBAR0109
    6 FORMAT('0CELL SAMPLE SIZES',/(20I6))                              MBAR0110
      READ 7,(R(I),I=1,ICORR)                                           MBAR0111
    7 FORMAT(20F4.0)                                                    MBAR0112
      PRINT 8,(R(I),I=1,ICORR)                                          MBAR0113
    8 FORMAT('0CORRELATIONS FOR CREATED MATRICES',/(20F6.2))            MBAR0114
      READ 7,(ES(I),I=1,IES)                                            MBAR0115
      PRINT 9,(ES(I),I=1,IES)                                           MBAR0116
    9 FORMAT('0EFFECT SIZES',/(20F6.3))                                 MBAR0117
      NTAB = ICORR*ISUB                                                 MBAR0118
      READ 1,(ITABLE(I),I=1,NTAB)                                       MBAR0119
      PRINT 10,(ITABLE(I),I=1,NTAB)                                     MBAR0120
```

```
   10 FORMAT('0THE TABLES TO BE PRINTED ARE :',(20A4))                  MBAR0121
C                                                                       MBAR0122
C-----------------------------------------------------------------------MBAR0123
C                                                                       MBAR0124
      ITAB = 0                                                          MBAR0125
      DO 18 I=1,ISUB                                                    MBAR0126
      N = NSUB(I)                                                       MBAR0127
      RN = N                                                            MBAR0128
C-----------------------------------------------------------------------MBAR0129
C   PRINT STATEMENTS THAT WERE MADE INTO COMMENT STATEMENTS MAY         MBAR0130
C   BE USED, BY DELETING THE C IN THE FIRST COLUMN, TO CHECK            MBAR0131
C   ON THE CALCULATIONS IN THIS PROGRAM.                                MBAR0132
C                                                                       MBAR0133
C     PRINT 1000,N,I,ISUB,RN                                            MBAR0134
C1000 FORMAT(3I7,F8.4)                                                  MBAR0135
C-----------------------------------------------------------------------MBAR0136
C-----------------------------------------------------------------------MBAR0137
C                                                                       MBAR0138
C   THE TWO DO 70 LOOPS ESTABLISH THE INTRACLASS CORRELATIONS.          MBAR0139
C   AND GROUP SIZE.                                                     MBAR0140
C                                                                       MBAR0141
      DO 18 J=1,ICORR                                                   MBAR0142
C-----------------------------------------------------------------------MBAR0143
      COR = R(J)                                                        MBAR0144
C-----------------------------------------------------------------------MBAR0145
C   ITABLE IS THE TABLE NUMBER                                          MBAR0146
C                                                                       MBAR0147
      ITAB = ITAB+1                                                     MBAR0148
C-----------------------------------------------------------------------MBAR0149
C     PRINT 1001,COR,I,J,ITAB,ICORR                                     MBAR0150
C1001 FORMAT(2X,F8.4,4I3)                                               MBAR0151
      PRINT 11,ITABLE(ITAB),N,COR                                       MBAR0152
   11 FORMAT(1H1,////,T62,'TABLE',A4,/,1H0,T33,'POWER BASED ON',I5,     MBAR0153
     >  ' ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS',/,1H0,T42,   MBAR0154
     >  'AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS',F5.2)         MBAR0155
      PRINT 12                                                          MBAR0156
   12 FORMAT(1H0,11X,21('-----'))                                       MBAR0157
      PRINT 13,(LE,LE=LEVEL1,LEVEL2)                                    MBAR0158
   13 FORMAT(T24,'1',T38,'2',/,12X,'UNITS',T20,'UNIT',T27,'EFFECT SIZE',MBAR0159
     >  T40,I2,' LEVELS / ALPHA',T61,I2,' LEVELS / ALPHA',T81,I2,       MBAR0160
     >  ' LEVELS / ALPHA',T101,I2,' LEVELS / ALPHA',/,T20,'SIZE',T27,   MBAR0161
     >  'ENTITY UNIT',T44,'.01  .05  .10',T64,'.01  .05  .10',T84,      MBAR0162
     >  '.01  .05  .10',T104,'.01  .05  .10')                           MBAR0163
      PRINT 12                                                          MBAR0164
      DO 18 M=1,4                                                       MBAR0165
      NG = NGROUP(M)                                                    MBAR0166
      RNG = NG                                                          MBAR0167
      NSG = N/NG                                                        MBAR0168
      RNSG = NSG                                                        MBAR0169
C     PRINT 1002,M,NG, NGROUP(M),NSG,RNG,RNSG                           MBAR0170
C1002 FORMAT(4I7,2F8.2)                                                 MBAR0171
C-----------------------------------------------------------------------MBAR0172
C   DO 16 ESTABLISHES EFFECT SIZES.                                     MBAR0173
C                                                                       MBAR0174
      DO 16 K=1,IES                                                     MBAR0175
C-----------------------------------------------------------------------MBAR0176
      RES = ES(K)                                                       MBAR0177
      ENTES = RES                                                       MBAR0178
C-----------------------------------------------------------------------MBAR0179
C   UNITES IS THE EFFECT SIZE FOR A GROUP AND IS BASED ON RNSG          MBAR0180
```

```
C  (THE NUMBER OF SUBJECTS IN A GROUP), COR (THE INTRACLASS             MBAR0181
C  CORRELATION), AND RES (THE ENTITY EFFECT SIZE).                      MBAR0182
C  THIS IS FORMULA (3.1.10) IN THE TEXT.                                MBAR0183
C                                                                       MBAR0184
      UNITES = SQRT(RNSG/(1.0+(RNSG-1.0)*COR))*RES                      MBAR0185
C-----------------------------------------------------------------------MBAR0186
C     PRINT 1003,K,IES,RES,ENTES,UNITES                                 MBAR0187
C1003 FORMAT(2I7,3F8.3)                                                 MBAR0188
C-----------------------------------------------------------------------MBAR0189
C  DO 14 ESTABLISHES LEVELS.                                            MBAR0190
C                                                                       MBAR0191
      DO 14 L=LEVEL1,LEVEL2                                             MBAR0192
C-----------------------------------------------------------------------MBAR0193
      RL = L                                                            MBAR0194
C-----------------------------------------------------------------------MBAR0195
C  RLAM IS THE NONCENTRALITY PARAMETER OF THE NONCENTRAL F DISTRIBUTION.MBAR0196
C  IT IS FOUND USING FORMULA 10.8.2 (P 462) IN COHEN, J. STATISTICAL   MBAR0197
C  POWER ANALYSIS FOR THE BEHAVIORAL SCIENCES.  NEW YORK: ACADEMIC     MBAR0198
C  PRESS, 1977.                                                         MBAR0199
C                                                                       MBAR0200
      RLAM = UNITES*UNITES*RNG*RL                                       MBAR0201
C-----------------------------------------------------------------------MBAR0202
C-----------------------------------------------------------------------MBAR0203
C  DF1 IS THE DEGREES OF FREEDOM FOR BETWEEN GROUPS                     MBAR0204
C  D1 IS THE DOUBLE PRECISIONED DF1                                     MBAR0205
C                                                                       MBAR0206
      D1 = RL-1.0                                                       MBAR0207
      DF1 = D1                                                          MBAR0208
C-----------------------------------------------------------------------MBAR0209
C-----------------------------------------------------------------------MBAR0210
C  DF2 IS THE NUMBER OF DEGREES OF FREEDOM ASSOCIATED WITH WITHIN       MBAR0211
C  TREATMENTS (ERROR)                                                   MBAR0212
C  D2 IS THE DOUBLE PRECISIONED DF2                                     MBAR0213
C                                                                       MBAR0214
      D2 = RL*(RNG-1.0)                                                 MBAR0215
      DF2 = D2                                                          MBAR0216
C-----------------------------------------------------------------------MBAR0217
C-----------------------------------------------------------------------MBAR0218
C  SUBROUTINE MDFI IS AN IMSL SUBROUTINE THAT RETURNS AN F VALUE        MBAR0219
C  THAT CORRESPONDS TO THE FIRST NUMBER IN ITS CALL STATEMENT           MBAR0220
C  (E.G., .99 OR 1 - ALPHA RETURNS THE F CALLED HERE REJ1)              MBAR0221
C                                                                       MBAR0222
      CALL MDFI(.99,DF1,DF2,REJ1,IER)                                   MBAR0223
      CALL MDFI(.95,DF1,DF2,REJ2,IER)                                   MBAR0224
      CALL MDFI(.90,DF1,DF2,REJ3,IER)                                   MBAR0225
C-----------------------------------------------------------------------MBAR0226
      FA = REJ1                                                         MBAR0227
C-----------------------------------------------------------------------MBAR0228
C  SEVZEL IS A SUBROUTINE THAT CALCULATES A Z SCORE ACCORDING TO        MBAR0229
C  FORMULA 10.8.1 (P 462) IN THE ABOVE REFERENCED TEXT BY COHEN.        MBAR0230
C                                                                       MBAR0231
      CALL SEVZEL(RLAM,D1,D2,FA,ZPOW)                                   MBAR0232
C-----------------------------------------------------------------------MBAR0233
C-----------------------------------------------------------------------MBAR0234
C  ZNORM IS A SUBROUTINE THAT CALCULATES THE AREA TO THE LEFT OF THE   MBAR0235
C  Z SCORE FOUND IN SEVZEL.  THIS AREA IS THE POWER OF THE F TEST.     MBAR0236
C                                                                       MBAR0237
      CALL ZNORM(ZPOW,FPR)                                              MBAR0238
C-----------------------------------------------------------------------MBAR0239
C-----------------------------------------------------------------------MBAR0240
```

```
C  POW1. POW2. POW3 ARE VECTORS THAT STORE POWER VALUES
C  CORRESPONDING TO ALPHAS OF .01. .05. .10. RESPECTIVELY.
C
      POW1(L) = FPR
C-----------------------------------------------------------------------
      FA = REJ2
      CALL SEVZEL(RLAM.D1.D2.FA.ZPOW)
      CALL ZNORM(ZPOW.FPR)
      POW2(L) = FPR
      FA = REJ3
      CALL SEVZEL(RLAM.D1.D2.FA.ZPOW)
      CALL ZNORM(ZPOW.FPR)
      POW3(L) = FPR
C     PRINT 1008.L.POW1(L).POW2(L),POW3(L).      REJ1,REJ2,REJ3
C1008 FORMAT(I5.6F8.3)
   14 CONTINUE
      PRINT 15.NG.NSG.ENTES.UNITES.(POW1(L).POW2(L).POW3(L).L=LEVEL1.
     >  LEVEL2)
   15 FORMAT(1H0.11X.I4.T20.I3.T27.F4.2.T34.F4.2.T42.3F5.2.T62.3F5.2.
     >  T82.3F5.2.T102.3F5.2)
   16 CONTINUE
      PRINT 12
      IF(M.EQ.4) PRINT 17
   17 FORMAT(/////.13X.'1'./.14X.'UNIT SIZE IS THE NUMBER OF ENTITIES '.
     >  'PER UNIT.'.///.13X.'2'./.14X.'THE ENTITY EFFECT SIZE IS THE '.
     >  'EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.')
   18 CONTINUE
      STOP
      END
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C  *****  MODIFIED OCTOBER 2, 1979.
C-----------------------------------------------------------------------
C ZNORM CALCULATES THE AREA UNDER THE UNIT NORMAL DISTRIBUTION TO THE
C LEFT OF X.
C-----------------------------------------------------------------------
C X IS WHAT IS COMMONLY CALLED A 'Z SCORE'.  THAT IS. A SCORE FROM THE
C NORMAL DISTRIBUTION WITH A MEAN OF 0 AND A VARIANCE OF 1.
C-----------------------------------------------------------------------
C THE METHOD USED TO ARRIVE AT THE AREA TO THE LEFT OF X IS DESCRIBED
C IN THE HANDBOOK OF MATHEMATICAL FUNCTIONS ON PAGE 932.
C-----------------------------------------------------------------------
C ZNORM REQUIRES THE FOLLOWING PARAMETERS:
C-----------------------------------------------------------------------
C X=Z-VALUE SENT FROM CALLING PROGRAM.
C AREA = AREA UNDER THE NORMAL CURVE TO THE LEFT OF Z.
C-----------------------------------------------------------------------
C
C-----------------------------------------------------------------------
      SUBROUTINE ZNORM(X.AREA)
      DOUBLE PRECISION AB(5).X.AREA.T.Z.A.TT
      DATA AB/.319381530D0.-.356563782D0.1.781477937D0.-1.821255978D0.
     >  1.330274429D0/
C **NOTE**  BECAUSE VALUES ARE REPORTED TO TWO DECIMAL PLACES
C           A Z VALUE GREATER THAN 2.58 RETURNS A PROBABILITY
C           OF 1.00 AND A Z VALUE LESS THAN -2.58 RETURNS A
C           PROBABILITY VALUE OF 0.00
      IF(DABS(X).GT.2.58D0) GO TO 1
      GO TO 2
```

```
    1 IF(X.LT.-2.58D0) AREA = 0.D0                                      MBAR0032
      IF(X.GT.2.58D0) AREA = 1.D0                                       MBAR0033
      RETURN                                                            MBAR0034
    2 T = 1.D0/(1.D0+.2316419D0*DABS(X))                                MBAR0035
      Z = DEXP(.5D0*(-X)*X)/2.506628273D0                               MBAR0036
      A = 0.0                                                           MBAR0037
      TT = 1.0                                                          MBAR0038
      DO 3 J=1,5                                                        MBAR0039
      TT = TT*T                                                         MBAR0040
    3 A = A+AB(J)*TT                                                    MBAR0041
      AREA = A*Z                                                        MBAR0042
      IF(X) 5,5,4                                                       MBAR0043
    4 AREA = 1.D0-AREA                                                  MBAR0044
    5 RETURN                                                            MBAR0045
      END                                                               MBAR0046
C-----------------------------------------------------------------------MBAR0001
C-----------------------------------------------------------------------MBAR0002
C SEVZEL CALCULATES THE STANDARD UNIT NORMAL DEVIATE WHICH WHEN SENT    MBAR0003
C TO ZNORM IS USED TO FINE THE POWER OF THE F-TEST IN A FIXED EFFECTS   MBAR0004
C ANALYSIS OF VARIANCE.                                                 MBAR0005
C-----------------------------------------------------------------------MBAR0006
C SEVZEL REQUIRES THE FOLLOWING PARAMETERS:                             MBAR0007
C-----------------------------------------------------------------------MBAR0008
C RLAM---NONCENTRALITY PARAMETER                                        MBAR0009
C U---DEGREES OF FREEDOM FOR THE NUMERATOR OF THE F-TEST                MBAR0010
C V---DEGREES OF FREEDOM FOR THE DENOMINATOR OF THE F-TEST              MBAR0011
C F---F VALUE REQUIRED FOR SIGNIFICANCE WITH U AND V.                   MBAR0012
C POW1--- SCORE RETURNED TO MAIN LINE WHICH WHEN SENT TO SUBROUTINE     MBAR0013
C ZNORM DETERMINES THE POWER.                                           MBAR0014
C-----------------------------------------------------------------------MBAR0015
C THE CALCULATIONS ARE BASED ON A METHOD DESCRIBED IN:  LAUBSCHER, N.F. MBAR0016
C NORMALIZING THE NONCENTRAL T AND F DISTRIBUTIONS.  ANNALS OF          MBAR0017
C MATHEMATICAL STATISTICS, 1960, 31, 1105-1112.                         MBAR0018
C-----------------------------------------------------------------------MBAR0019
C                                                                       MBAR0020
C-----------------------------------------------------------------------MBAR0021
      SUBROUTINE SEVZEL(RLAM,U,V,F,POW1)                                MBAR0022
      DOUBLE PRECISION RLAM,U,V,F,POW1,TEMP1,TEMP2,TEMP3                MBAR0023
      TEMP1 = DSQRT(2.D0*(U+RLAM)-(U+2.D0*RLAM)/(U+RLAM))               MBAR0024
      TEMP2 = DSQRT(((2.D0*V-1.D0)*U*F)/V)                              MBAR0025
      TEMP3 = DSQRT((U*F)/V+(U+2.D0*RLAM)/(U+RLAM))                     MBAR0026
      POW1 = (TEMP1-TEMP2)/TEMP3                                        MBAR0027
      RETURN                                                            MBAR0028
      END                                                               MBAR0029
```

```
  FINAL RUN
 WHITE PAPER

THE SEED VALUE IS       141577111

NUMBER OF DIFFERENT SAMPLE SIZES     1

INITIAL NUMBER OF LEVELS    2

TERMINAL NUMBER OF LEVELS    5

NUMBER OF REPLICATIONS  1000

SUBROUTINE VALUE IS  2          * 1 = READ. 2 = CREATE *

NUMBER OF CORRELATIONAL VALUES  1

NUMBER OF EFFECT SIZES  3

CELL SAMPLE SIZES
   40

CORRELATIONS FOR CREATED MATRICES
 0.20

EFFECT SIZES
0.100 0.250 0.400

THE TABLES TO BE PRINTED ARE :
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```
*EXECUTION TIME FOR MBAR ON AN IBM 370 WAS 5 MIN. 7.25 SEC.
```

```
*
 THE FOLLOWING CARD INPUT GENERATED THE PROGRAM OUTPUT ON THE
 FOLLOWING PAGE AND TABLES 4.3.1 - 4.3.36
*
 THE FIRST AND LAST TWO CARDS SERVE TO IDENTIFY COLUMNS AND
 ARE NOT PART OF THE CARD INPUT
*

00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890

 FINAL RUN MBAR
 WHITE PAPER
   9   2   5   4   3
  20  40  60  80 100 140 160 2001000
 0.0 .20 .50 .80
 .10 .25 .40


00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

← The two table identification cards were left blank, so that the tables could be numbered on a typewriter.

```
  FINAL RUN MBAR
 WHITE PAPER

 NUMBER OF DIFFERENT SAMPLE SIZES     9

INITIAL NUMBER OF LEVELS     2

TERMINAL NUMBER OF LEVELS     5

NUMBER OF CORRELATIONAL VALUES   4

NUMBER OF EFFECT SIZES   3

CELL SAMPLE SIZES
    20     40     60     80    100    140    160    200   1000

CORRELATIONS FOR CREATED MATRICES
 0.0    0.20   0.50   0.80

EFFECT SIZES
0.100 0.250 0.400

THE TABLES TO BE PRINTED ARE :
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TABLE 4.2.1

ESTIMATED POWER WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND

THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20:

BASED ON 40 ENTITIES AND 1000 REPLICATIONS

UNITS	UNIT SIZE	EFFECT SIZE ENT UNIT EST	2 LEVELS / ALPHA			EFFECT SIZE	3 LEVELS / ALPHA			EFFECT SIZE	4 LEVELS / ALPHA			EFFECT SIZE	5 LEVELS / ALPHA		
			.01	.05	.10		.01	.05	.10		.01	.05	.10		.01	.05	.10
20	2	0.10/0.13/ 0.16	0.03	0.12	0.19	0.21	0.03	0.13	0.23	0.22	0.05	0.16	0.25	0.23	0.04	0.16	0.24
20	2	0.25/0.32/ 0.33	0.27	0.50	0.62	0.36	0.35	0.59	0.70	0.36	0.38	0.64	0.75	0.37	0.47	0.69	0.80
20	2	0.40/0.52/ 0.53	0.69	0.89	0.93	0.54	0.85	0.96	0.97	0.55	0.91	0.98	0.99	0.55	0.96	0.99	0.99
10	4	0.10/0.16/ 0.23	0.02	0.11	0.18	0.28	0.03	0.11	0.19	0.31	0.04	0.13	0.22	0.31	0.02	0.10	0.19
10	4	0.25/0.40/ 0.42	0.16	0.39	0.51	0.45	0.21	0.44	0.57	0.47	0.25	0.49	0.63	0.47	0.31	0.55	0.69
10	4	0.40/0.63/ 0.66	0.48	0.75	0.87	0.67	0.60	0.84	0.91	0.69	0.73	0.89	0.95	0.69	0.82	0.93	0.97
5	8	0.10/0.16/ 0.32	0.02	0.06	0.14	0.40	0.02	0.08	0.15	0.41	0.02	0.08	0.13	0.43	0.02	0.10	0.18
5	8	0.25/0.46/ 0.54	0.07	0.25	0.38	0.57	0.09	0.25	0.38	0.60	0.12	0.31	0.45	0.60	0.13	0.31	0.46
5	8	0.40/0.73/ 0.82	0.23	0.53	0.69	0.82	0.28	0.58	0.73	0.86	0.39	0.70	0.81	0.84	0.47	0.74	0.85
2	20	0.10/0.20/ 0.78	0.01	0.05	0.09	0.73	0.01	0.05	0.09	0.75	0.01	0.06	0.12	0.72	0.00	0.05	0.10
2	20	0.25/0.51/ 1.16	0.03	0.09	0.19	0.95	0.02	0.10	0.18	0.92	0.03	0.10	0.19	0.91	0.04	0.12	0.21
2	20	0.40/0.82/ 1.50	0.03	0.18	0.34	1.31	0.04	0.18	0.33	1.22	0.06	0.21	0.35	1.17	0.06	0.24	0.38

TABLE 4.2.2

POWER BASED ON 40 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	2	0.10	0.13	0.03	0.12	0.21	0.03	0.13	0.22	0.03	0.13	0.23	0.04	0.14	0.24
20	2	0.25	0.32	0.26	0.52	0.66	0.33	0.59	0.71	0.40	0.66	0.77	0.47	0.72	0.82
20	2	0.40	0.52	0.71	0.90	0.95	0.83	0.95	0.98	0.91	0.98	0.99	0.96	0.99	1.00
10	4	0.10	0.16	0.02	0.10	0.18	0.02	0.10	0.18	0.02	0.11	0.19	0.03	0.11	0.20
10	4	0.25	0.40	0.16	0.39	0.54	0.20	0.44	0.58	0.24	0.50	0.63	0.29	0.55	0.68
10	4	0.40	0.63	0.50	0.77	0.87	0.62	0.85	0.92	0.73	0.91	0.95	0.82	0.94	0.97
5	8	0.10	0.18	0.02	0.08	0.15	0.02	0.08	0.15	0.02	0.08	0.15	0.02	0.08	0.16
5	8	0.25	0.46	0.08	0.25	0.38	0.09	0.27	0.41	0.11	0.30	0.44	0.13	0.34	0.48
5	8	0.40	0.73	0.23	0.53	0.69	0.30	0.60	0.74	0.38	0.68	0.80	0.47	0.74	0.85
2	20	0.10	0.20	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.02	0.07	0.13
2	20	0.25	0.51	0.07	0.13	0.21	0.05	0.12	0.20	0.04	0.12	0.21	0.04	0.13	0.22
2	20	0.40	0.82	0.09	0.19	0.31	0.07	0.20	0.32	0.07	0.22	0.35	0.08	0.24	0.39

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

APPENDIX 2

Power Tables From the Mathematical Power Program "MBAR" Where the Number of Entities Per Treatment Is Held Constant

B.1. Introduction

This appendix contains power values that were generated using the formulas in Section 3. In these tables the number of entities per treatment (cell) was held constant while the number of groups (units varied over 20, 10, 5 and 2. The power values were generated for:

a) Level of significance (α) = .01, .05, .10,

b) Effect size for entities (f) = .10, .25, .40,

c) Relationship among the entities in a group (ρ) = 0.0, .20, .50, .80,

d) Entities per cell (n) = 20, 40, 60, 80, 100, 140, 160, 200, 1000,

e) Number of groups = 20, 10, 5, 2,

f) Treatment levels = 2(1)5.

Note that these power values may be inaccurate (by as much as ±.08) when the number of units per treatment is small (e.g. 2 units per treatment level).

TABLE 4.3.1

POWER BASED ON 20 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS

AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	1	0.10	0.10	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.18
20	1	0.25	0.25	0.14	0.34	0.48	0.17	0.38	0.52	0.20	0.43	0.56	0.24	0.47	0.61
20	1	0.40	0.40	0.44	0.70	0.81	0.55	0.78	0.87	0.65	0.85	0.91	0.74	0.90	0.94
10	2	0.10	0.14	0.02	0.08	0.16	0.02	0.09	0.17	0.02	0.09	0.17	0.02	0.10	0.18
10	2	0.25	0.35	0.12	0.33	0.47	0.15	0.36	0.50	0.18	0.41	0.54	0.21	0.45	0.59
10	2	0.40	0.57	0.39	0.68	0.80	0.50	0.75	0.85	0.60	0.83	0.90	0.69	0.88	0.93
5	4	0.10	0.20	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
5	4	0.25	0.50	0.10	0.29	0.43	0.11	0.32	0.46	0.14	0.36	0.50	0.17	0.40	0.54
5	4	0.40	0.80	0.29	0.61	0.76	0.38	0.69	0.81	0.48	0.76	0.87	0.57	0.83	0.91
2	10	0.10	0.32	0.06	0.11	0.16	0.04	0.09	0.15	0.03	0.09	0.15	0.03	0.09	0.15
2	10	0.25	0.79	0.08	0.18	0.30	0.07	0.19	0.31	0.07	0.21	0.34	0.08	0.23	0.37
2	10	0.40	1.26	0.12	0.31	0.50	0.12	0.36	0.56	0.15	0.44	0.63	0.19	0.51	0.70

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.2

POWER BASED ON 20 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	1	0.10	0.10	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.18
20	1	0.25	0.25	0.14	0.34	0.48	0.17	0.38	0.52	0.20	0.43	0.56	0.24	0.47	0.61
20	1	0.40	0.40	0.44	0.70	0.81	0.55	0.78	0.87	0.65	0.85	0.91	0.74	0.90	0.94
10	2	0.10	0.13	0.02	0.08	0.15	0.02	0.08	0.16	0.02	0.08	0.16	0.02	0.09	0.16
10	2	0.25	0.32	0.10	0.28	0.41	0.12	0.31	0.44	0.14	0.34	0.48	0.16	0.38	0.52
10	2	0.40	0.52	0.32	0.60	0.73	0.40	0.67	0.79	0.49	0.75	0.84	0.58	0.81	0.89
5	4	0.10	0.16	0.02	0.07	0.14	0.02	0.07	0.14	0.02	0.07	0.14	0.02	0.08	0.14
5	4	0.25	0.40	0.06	0.20	0.32	0.07	0.21	0.33	0.08	0.23	0.36	0.09	0.26	0.39
5	4	0.40	0.63	0.17	0.43	0.58	0.21	0.48	0.63	0.26	0.54	0.69	0.32	0.60	0.74
2	10	0.10	0.19	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.07	0.13	0.02	0.07	0.12
2	10	0.25	0.47	0.07	0.13	0.20	0.05	0.12	0.19	0.04	0.11	0.19	0.04	0.12	0.20
2	10	0.40	0.76	0.08	0.18	0.29	0.07	0.18	0.30	0.07	0.19	0.32	0.07	0.22	0.35

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.3

POWER BASED ON 20 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	1	0.10	0.10	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.18
20	1	0.25	0.25	0.14	0.34	0.48	0.17	0.38	0.52	0.20	0.43	0.56	0.24	0.47	0.61
20	1	0.40	0.40	0.44	0.70	0.81	0.55	0.78	0.87	0.65	0.85	0.91	0.74	0.90	0.94
10	2	0.10	0.12	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15	0.02	0.08	0.15
10	2	0.25	0.29	0.07	0.23	0.36	0.09	0.25	0.38	0.10	0.28	0.41	0.12	0.31	0.44
10	2	0.40	0.46	0.24	0.51	0.65	0.30	0.57	0.70	0.37	0.64	0.76	0.44	0.70	0.81
5	4	0.10	0.13	0.01	0.06	0.12	0.01	0.06	0.13	0.01	0.06	0.13	0.01	0.07	0.13
5	4	0.25	0.32	0.04	0.14	0.24	0.04	0.15	0.25	0.05	0.16	0.27	0.05	0.17	0.28
5	4	0.40	0.51	0.10	0.29	0.44	0.12	0.32	0.47	0.14	0.36	0.31	0.17	0.41	0.55
2	10	0.10	0.13	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	10	0.25	0.34	0.06	0.11	0.16	0.04	0.10	0.16	0.03	0.09	0.15	0.03	0.09	0.16
2	10	0.40	0.54	0.07	0.14	0.21	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.23

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.4

POWER BASED ON 20 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	1	0.10	0.10	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.18
20	1	0.25	0.25	0.14	0.34	0.48	0.17	0.38	0.52	0.20	0.43	0.56	0.24	0.47	0.61
20	1	0.40	0.40	0.44	0.70	0.81	0.55	0.78	0.87	0.65	0.85	0.91	0.74	0.90	0.94
10	2	0.10	0.11	0.01	0.07	0.13	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14
10	2	0.25	0.26	0.06	0.20	0.32	0.07	0.21	0.33	0.08	0.24	0.36	0.09	0.26	0.38
10	2	0.40	0.42	0.19	0.44	0.58	0.24	0.49	0.63	0.29	0.55	0.68	0.35	0.61	0.73
5	4	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	4	0.25	0.27	0.03	0.12	0.21	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.14	0.23
5	4	0.40	0.43	0.07	0.23	0.36	0.06	0.25	0.38	0.10	0.28	0.41	0.11	0.30	0.44
2	10	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	10	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	10	0.40	0.44	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.18	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.5

POWER BASED ON 40 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS

AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	EFFECT SIZE UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	2	0.10	0.14	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.26	0.05	0.17	0.27
20	2	0.25	0.35	0.33	0.60	0.72	0.41	0.67	0.78	0.50	0.74	0.84	0.58	0.80	0.88
20	2	0.40	0.57	0.81	0.94	0.97	0.91	0.98	0.99	0.96	0.99	1.00	0.98	1.00	1.00
10	4	0.10	0.20	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25	0.04	0.16	0.26
10	4	0.25	0.50	0.29	0.57	0.71	0.37	0.64	0.76	0.45	0.71	0.82	0.54	0.78	0.87
10	4	0.40	0.80	0.75	0.93	0.97	0.87	0.97	0.99	0.94	0.99	1.00	0.97	1.00	1.00
5	8	0.10	0.28	0.03	0.12	0.22	0.03	0.13	0.22	0.04	0.14	0.23	0.04	0.14	0.24
5	8	0.25	0.71	0.22	0.51	0.67	0.28	0.57	0.72	0.35	0.65	0.78	0.43	0.71	0.83
5	8	0.40	1.13	0.60	0.88	0.95	0.76	0.94	0.98	0.87	0.97	0.99	0.93	0.99	1.00
2	20	0.10	0.45	0.07	0.12	0.19	0.06	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19
2	20	0.25	1.12	0.10	0.27	0.44	0.10	0.30	0.48	0.12	0.36	0.54	0.15	0.41	0.60
2	20	0.40	1.79	0.16	0.48	0.73	0.21	0.60	0.81	0.31	0.72	0.89	0.42	0.82	0.94

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.6

POWER BASED ON 40 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	2	0.10	0.13	0.03	0.12	0.21	0.03	0.13	0.22	0.03	0.13	0.23	0.04	0.14	0.24
20	2	0.25	0.32	0.26	0.52	0.66	0.33	0.59	0.71	0.40	0.66	0.77	0.47	0.72	0.82
20	2	0.40	0.52	0.71	0.90	0.95	0.83	0.95	0.98	0.91	0.98	0.99	0.96	0.99	1.00
10	4	0.10	0.16	0.02	0.10	0.18	0.02	0.10	0.18	0.02	0.11	0.19	0.03	0.11	0.20
10	4	0.25	0.40	0.16	0.39	0.54	0.20	0.44	0.58	0.24	0.50	0.63	0.29	0.55	0.68
10	4	0.40	0.63	0.50	0.77	0.87	0.62	0.85	0.92	0.73	0.91	0.95	0.82	0.94	0.97
5	8	0.10	0.18	0.02	0.08	0.15	0.02	0.08	0.15	0.02	0.08	0.15	0.02	0.08	0.16
5	8	0.25	0.46	0.08	0.25	0.38	0.09	0.27	0.41	0.11	0.30	0.44	0.13	0.34	0.48
5	8	0.40	0.73	0.23	0.53	0.69	0.30	0.60	0.74	0.38	0.68	0.80	0.47	0.74	0.85
2	20	0.10	0.20	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.02	0.07	0.13
2	20	0.25	0.51	0.07	0.13	0.21	0.05	0.12	0.20	0.04	0.12	0.21	0.04	0.13	0.22
2	20	0.40	0.82	0.09	0.19	0.31	0.07	0.20	0.32	0.07	0.22	0.35	0.08	0.24	0.39

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.7

POWER BASED ON 40 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	2	0.10	0.12	0.02	0.10	0.19	0.02	0.11	0.19	0.03	0.11	0.20	0.03	0.12	0.21
20	2	0.25	0.29	0.20	0.44	0.58	0.25	0.49	0.62	0.30	0.55	0.68	0.36	0.61	0.73
20	2	0.40	0.46	0.59	0.82	0.90	0.72	0.89	0.94	0.82	0.94	0.97	0.88	0.97	0.98
10	4	0.10	0.13	0.02	0.08	0.15	0.02	0.08	0.15	0.02	0.08	0.16	0.02	0.09	0.16
10	4	0.25	0.32	0.09	0.27	0.40	0.11	0.30	0.43	0.13	0.33	0.46	0.15	0.36	0.50
10	4	0.40	0.51	0.30	0.58	0.72	0.38	0.65	0.77	0.47	0.73	0.83	0.55	0.79	0.87
5	8	0.10	0.13	0.01	0.06	0.12	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	8	0.25	0.33	0.04	0.15	0.26	0.05	0.16	0.27	0.05	0.17	0.29	0.06	0.19	0.30
5	8	0.40	0.53	0.11	0.32	0.47	0.13	0.36	0.50	0.17	0.40	0.55	0.20	0.45	0.60
2	20	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	20	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	20	0.40	0.55	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.13	0.22	0.05	0.14	0.24

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.8

POWER BASED ON 40 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	2	0.10	0.11	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.19	0.02	0.11	0.19
20	2	0.25	0.26	0.18	0.38	0.51	0.19	0.42	0.55	0.23	0.47	0.60	0.28	0.52	0.65
20	2	0.40	0.42	0.49	0.75	0.85	0.61	0.83	0.90	0.71	0.89	0.94	0.80	0.93	0.96
10	4	0.10	0.11	0.01	0.07	0.13	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.07	0.14
10	4	0.25	0.27	0.06	0.21	0.33	0.07	0.23	0.35	0.09	0.25	0.37	0.10	0.27	0.40
10	4	0.40	0.43	0.21	0.46	0.60	0.26	0.51	0.65	0.32	0.58	0.71	0.38	0.64	0.76
5	8	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	8	0.25	0.28	0.03	0.12	0.21	0.03	0.12	0.22	0.03	0.13	0.23	0.04	0.14	0.24
5	8	0.40	0.44	0.07	0.23	0.37	0.08	0.25	0.39	0.10	0.28	0.42	0.12	0.31	0.45
2	20	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	20	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	20	0.40	0.44	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.9

POWER BASED ON 60 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
	SIZE	ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	3	0.10	0.17	0.05	0.18	0.30	0.06	0.20	0.31	0.07	0.22	0.33	0.08	0.24	0.36
20	3	0.25	0.43	0.52	0.77	0.86	0.64	0.85	0.91	0.75	0.90	0.95	0.83	0.94	0.97
20	3	0.40	0.69	0.95	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	6	0.10	0.24	0.05	0.18	0.29	0.06	0.19	0.30	0.07	0.21	0.32	0.07	0.23	0.35
10	6	0.25	0.61	0.47	0.74	0.85	0.59	0.82	0.90	0.70	0.88	0.94	0.78	0.93	0.96
10	6	0.40	0.98	0.92	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	12	0.10	0.35	0.05	0.16	0.27	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.32
5	12	0.25	0.87	0.35	0.68	0.81	0.46	0.76	0.87	0.57	0.83	0.91	0.67	0.89	0.95
5	12	0.40	1.39	0.81	0.97	0.99	0.93	0.99	1.00	0.98	1.00	1.00	0.99	1.00	1.00
2	30	0.10	0.55	0.07	0.14	0.22	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.23
2	30	0.25	1.37	0.12	0.34	0.55	0.14	0.41	0.62	0.18	0.49	0.70	0.23	0.58	0.77
2	30	0.40	2.19	0.20	0.61	0.85	0.31	0.76	0.93	0.46	0.88	0.97	0.62	0.95	0.99

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.10

POWER BASED ON 60 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	3	0.10	0.15	0.04	0.14	0.24	0.04	0.15	0.25	0.05	0.16	0.27	0.05	0.18	0.28
20	3	0.25	0.37	0.36	0.63	0.75	0.45	0.70	0.81	0.54	0.77	0.86	0.63	0.83	0.90
20	3	0.40	0.59	0.84	0.95	0.98	0.93	0.98	0.99	0.97	0.99	1.00	0.99	1.00	1.00
10	6	0.10	0.17	0.02	0.11	0.20	0.03	0.11	0.20	0.03	0.12	0.21	0.03	0.13	0.22
10	6	0.25	0.43	0.20	0.46	0.60	0.25	0.51	0.65	0.31	0.58	0.71	0.38	0.64	0.76
10	6	0.40	0.69	0.60	0.84	0.91	0.73	0.91	0.95	0.83	0.95	0.98	0.90	0.98	0.99
5	12	0.10	0.19	0.02	0.08	0.15	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17
5	12	0.25	0.48	0.09	0.27	0.42	0.11	0.30	0.44	0.13	0.34	0.48	0.15	0.37	0.52
5	12	0.40	0.77	0.27	0.58	0.73	0.35	0.66	0.79	0.44	0.73	0.86	0.53	0.80	0.89
2	30	0.10	0.21	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.02	0.07	0.13
2	30	0.25	0.53	0.07	0.13	0.21	0.05	0.12	0.21	0.04	0.13	0.21	0.04	0.13	0.22
2	30	0.40	0.84	0.09	0.20	0.32	0.07	0.20	0.34	0.08	0.23	0.37	0.08	0.25	0.40

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.11

POWER BASED ON 60 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	3	0.10	0.12	0.02	0.11	0.20	0.03	0.12	0.21	0.03	0.12	0.22	0.03	0.13	0.23
20	3	0.25	0.31	0.23	0.48	0.62	0.29	0.54	0.67	0.35	0.61	0.73	0.42	0.67	0.78
20	3	0.40	0.49	0.66	0.86	0.92	0.78	0.92	0.96	0.87	0.96	0.98	0.93	0.98	0.99
10	6	0.10	0.13	0.02	0.08	0.15	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17
10	6	0.25	0.33	0.10	0.29	0.42	0.12	0.31	0.45	0.14	0.35	0.49	0.17	0.39	0.53
10	6	0.40	0.52	0.33	0.61	0.74	0.41	0.68	0.80	0.51	0.76	0.85	0.59	0.82	0.89
5	12	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	12	0.25	0.34	0.04	0.16	0.26	0.05	0.17	0.27	0.05	0.18	0.29	0.06	0.19	0.31
5	12	0.40	0.54	0.12	0.33	0.48	0.14	0.37	0.52	0.17	0.42	0.56	0.21	0.46	0.61
2	30	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	30	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	30	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.13	0.23	0.05	0.14	0.24

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.12

POWER BASED ON 60 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT[1] SIZE	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	3	0.10	0.11	0.02	0.09	0.18	0.02	0.10	0.18	0.02	0.10	0.19	0.03	0.11	0.20
20	3	0.25	0.27	0.17	0.39	0.53	0.20	0.43	0.57	0.25	0.49	0.62	0.29	0.54	0.67
20	3	0.40	0.43	0.51	0.76	0.86	0.63	0.84	0.91	0.74	0.90	0.95	0.82	0.94	0.97
10	6	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	6	0.25	0.27	0.07	0.21	0.33	0.08	0.23	0.35	0.09	0.25	0.38	0.10	0.28	0.41
10	6	0.40	0.44	0.21	0.47	0.61	0.26	0.52	0.66	0.32	0.59	0.72	0.39	0.65	0.77
5	12	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	12	0.25	0.28	0.03	0.12	0.21	0.03	0.12	0.22	0.03	0.13	0.23	0.04	0.14	0.24
5	12	0.40	0.44	0.07	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.42	0.12	0.32	0.46
2	30	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	30	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	30	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.13

POWER BASED ON 80 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT[1]	EFFECT	SIZE[2]	2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
	SIZE	ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	4	0.10	0.20	0.08	0.23	0.36	0.09	0.26	0.38	0.11	0.28	0.41	0.12	0.31	0.44
20	4	0.25	0.50	0.68	0.88	0.93	0.80	0.93	0.97	0.89	0.97	0.99	0.94	0.99	0.99
20	4	0.40	0.80	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	8	0.10	0.28	0.07	0.22	0.35	0.08	0.24	0.37	0.10	0.27	0.40	0.11	0.29	0.43
10	8	0.25	0.71	0.62	0.85	0.92	0.75	0.92	0.96	0.85	0.96	0.98	0.91	0.98	0.99
10	8	0.40	1.13	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	16	0.10	0.40	0.06	0.20	0.32	0.07	0.22	0.34	0.08	0.24	0.37	0.09	0.26	0.39
5	16	0.25	1.00	0.48	0.80	0.90	0.62	0.87	0.94	0.74	0.93	0.97	0.83	0.96	0.99
5	16	0.40	1.60	0.92	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	40	0.10	0.63	0.08	0.15	0.24	0.06	0.15	0.24	0.05	0.15	0.26	0.05	0.17	0.28
2	40	0.25	1.58	0.14	0.41	0.64	0.17	0.50	0.72	0.24	0.61	0.81	0.32	0.71	0.87
2	40	0.40	2.53	0.24	0.71	0.92	0.40	0.87	0.97	0.60	0.95	0.99	0.78	0.99	1.00

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.14

POWER BASED ON 80 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	4	0.10	0.16	0.04	0.16	0.27	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.31
20	4	0.25	0.40	0.43	0.69	0.80	0.53	0.77	0.86	0.64	0.84	0.91	0.72	0.89	0.94
20	4	0.40	0.63	0.90	0.98	0.99	0.97	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00
10	8	0.10	0.18	0.03	0.12	0.21	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.14	0.23
10	8	0.25	0.46	0.23	0.50	0.64	0.29	0.56	0.69	0.36	0.63	0.75	0.43	0.69	0.80
10	8	0.40	0.73	0.65	0.88	0.94	0.79	0.93	0.97	0.88	0.97	0.99	0.94	0.99	0.99
5	16	0.10	0.20	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
5	16	0.25	0.50	0.10	0.29	0.43	0.11	0.32	0.46	0.14	0.36	0.50	0.17	0.40	0.54
5	16	0.40	0.80	0.29	0.61	0.76	0.38	0.69	0.81	0.48	0.76	0.87	0.57	0.83	0.91
2	40	0.10	0.21	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.03	0.07	0.13
2	40	0.25	0.53	0.07	0.14	0.21	0.05	0.13	0.21	0.04	0.13	0.22	0.04	0.13	0.23
2	40	0.40	0.85	0.09	0.20	0.33	0.07	0.21	0.34	0.08	0.23	0.38	0.09	0.26	0.41

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.15

POWER BASED ON 80 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	4	0.10	0.13	0.03	0.11	0.21	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.14	0.24
20	4	0.25	0.32	0.25	0.51	0.64	0.31	0.57	0.70	0.38	0.64	0.75	0.45	0.70	0.80
20	4	0.40	0.51	0.69	0.88	0.94	0.81	0.94	0.97	0.90	0.97	0.99	0.95	0.99	0.99
10	8	0.10	0.13	0.02	0.08	0.15	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17
10	8	0.25	0.33	0.11	0.30	0.43	0.13	0.32	0.46	0.15	0.36	0.50	0.18	0.40	0.54
10	8	0.40	0.53	0.34	0.63	0.75	0.43	0.70	0.81	0.53	0.77	0.86	0.62	0.83	0.90
5	16	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	16	0.25	0.34	0.04	0.16	0.27	0.05	0.17	0.28	0.05	0.18	0.30	0.06	0.20	0.32
5	16	0.40	0.55	0.12	0.34	0.49	0.15	0.37	0.52	0.18	0.42	0.57	0.22	0.47	0.62
2	40	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	40	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	40	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.13	0.23	0.05	0.14	0.24

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.16

POWER BASED ON 80 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	4	0.10	0.11	0.02	0.09	0.18	0.02	0.10	0.18	0.02	0.11	0.19	0.03	0.11	0.20
20	4	0.25	0.27	0.17	0.39	0.53	0.21	0.44	0.58	0.25	0.49	0.63	0.30	0.55	0.67
20	4	0.40	0.43	0.52	0.77	0.85	0.64	0.85	0.91	0.75	0.90	0.95	0.83	0.94	0.97
10	8	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	8	0.25	0.28	0.07	0.21	0.34	0.08	0.23	0.35	0.09	0.26	0.38	0.18	0.28	0.41
10	8	0.40	0.44	0.2[illegible]	0.47	0.61	0.27	0.53	0.66	0.33	0.59	0.72	0.39	0.65	0.77
5	16	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	16	0.25	0.28	0.03	0.12	0.21	0.03	0.12	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	16	0.40	0.44	0.07	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.42	0.12	0.32	0.46
2	40	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	40	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	40	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.17

POWER BASED ON 100 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	EFFECT SIZE[2] UNIT	2 LEVELS / ALPHA .01	2 LEVELS / ALPHA .05	2 LEVELS / ALPHA .10	3 LEVELS / ALPHA .01	3 LEVELS / ALPHA .05	3 LEVELS / ALPHA .10	4 LEVELS / ALPHA .01	4 LEVELS / ALPHA .05	4 LEVELS / ALPHA .10	5 LEVELS / ALPHA .01	5 LEVELS / ALPHA .05	5 LEVELS / ALPHA .10
20	5	0.10	0.22	0.10	0.28	0.41	0.12	0.31	0.44	0.15	0.35	0.48	0.17	0.39	0.52
20	5	0.25	0.56	0.79	0.94	0.97	0.90	0.97	0.99	0.96	0.99	1.00	0.98	1.00	1.00
20	5	0.40	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	10	0.10	0.32	0.09	0.27	0.40	0.11	0.30	0.43	0.13	0.33	0.46	0.15	0.36	0.50
10	10	0.25	0.79	0.74	0.92	0.96	0.86	0.97	0.99	0.93	0.99	0.99	0.97	1.00	1.00
10	10	0.40	1.26	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	20	0.10	0.45	0.08	0.24	0.37	0.09	0.26	0.40	0.10	0.29	0.43	0.12	0.32	0.46
5	20	0.25	1.12	0.59	0.87	0.95	0.74	0.94	0.97	0.86	0.97	0.99	0.93	0.99	1.00
5	20	0.40	1.79	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	50	0.10	0.71	0.08	0.17	0.27	0.06	0.17	0.27	0.06	0.18	0.30	0.06	0.19	0.32
2	50	0.25	1.77	0.16	0.47	0.72	0.21	0.59	0.81	0.30	0.71	0.88	0.41	0.81	0.93
2	50	0.40	2.83	0.28	0.79	0.96	0.48	0.93	0.99	0.71	0.98	1.00	0.88	1.00	1.00

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.18

POWER BASED ON 100 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	5	0.10	0.17	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.32	0.07	0.22	0.34
20	5	0.25	0.42	0.48	0.74	0.84	0.60	0.82	0.89	0.70	0.88	0.93	0.78	0.92	0.96
20	5	0.40	0.67	0.93	0.99	0.99	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	10	0.10	0.19	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.14	0.23	0.04	0.14	0.24
10	10	0.25	0.47	0.25	0.52	0.67	0.32	0.59	0.72	0.40	0.66	0.78	0.47	0.72	0.83
10	10	0.40	0.76	0.69	0.90	0.95	0.82	0.95	0.98	0.91	0.98	0.99	0.95	0.99	1.00
5	20	0.10	0.20	0.02	0.09	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
5	20	0.25	0.51	0.10	0.30	0.44	0.12	0.33	0.47	0.15	0.37	0.52	0.18	0.41	0.56
5	20	0.40	0.82	0.30	0.63	0.77	0.40	0.71	0.83	0.50	0.78	0.88	0.60	0.84	0.92
2	50	0.10	0.22	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.03	0.07	0.13
2	50	0.25	0.54	0.07	0.14	0.21	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.23
2	50	0.40	0.86	0.09	0.20	0.33	0.07	0.21	0.35	0.08	0.23	0.38	0.09	0.26	0.42

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.19

POWER BASED ON 100 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	5	0.10	0.13	0.03	0.12	0.21	0.03	0.13	0.22	0.03	0.13	0.23	0.04	0.14	0.24
20	5	0.25	0.32	0.26	0.52	0.66	0.33	0.59	0.71	0.40	0.66	0.77	0.47	0.72	0.82
20	5	0.40	0.52	0.71	0.90	0.95	0.83	0.95	0.98	0.91	0.98	0.99	0.96	0.99	1.00
10	10	0.10	0.13	0.02	0.08	0.16	0.02	0.08	0.16	0.02	0.09	0.17	0.02	0.09	0.17
10	10	0.25	0.34	0.11	0.30	0.44	0.13	0.33	0.47	0.16	0.37	0.51	0.18	0.41	0.55
10	10	0.40	0.54	0.35	0.64	0.76	0.44	0.71	0.82	0.54	0.78	0.87	0.63	0.84	0.91
5	20	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	20	0.25	0.35	0.05	0.16	0.27	0.05	0.17	0.28	0.06	0.18	0.30	0.06	0.20	0.32
5	20	0.40	0.55	0.12	0.34	0.49	0.15	0.36	0.53	0.18	0.43	0.58	0.22	0.48	0.62
2	50	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	50	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	50	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.14	0.23	0.05	0.14	0.24

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.20

POWER BASED ON 100 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	5	0.10	0.11	0.02	0.10	0.18	0.02	0.10	0.18	0.02	0.11	0.19	0.03	0.11	0.20
20	5	0.25	0.27	0.17	0.40	0.54	0.21	0.44	0.58	0.26	0.50	0.63	0.30	0.55	0.68
20	5	0.40	0.44	0.53	0.78	0.87	0.65	0.85	0.92	0.75	0.91	0.95	0.83	0.95	0.97
10	10	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	10	0.25	0.28	0.07	0.21	0.34	0.08	0.23	0.36	0.09	0.26	0.38	0.10	0.28	0.41
10	10	0.40	0.44	0.22	0.47	0.62	0.27	0.53	0.67	0.33	0.60	0.72	0.40	0.66	0.77
5	20	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	20	0.25	0.28	0.03	0.12	0.21	0.03	0.12	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	20	0.40	0.44	0.07	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.42	0.12	0.32	0.46
2	50	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	50	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	50	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.21

POWER BASED ON 140 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	7	0.10	0.26	0.16	0.38	0.52	0.19	0.42	0.56	0.24	0.47	0.61	0.28	0.52	0.65
20	7	0.25	0.66	0.93	0.98	0.99	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00
20	7	0.40	1.06	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	14	0.10	0.37	0.14	0.36	0.50	0.17	0.40	0.54	0.21	0.45	0.59	0.25	0.50	0.63
10	14	0.25	0.94	0.89	0.98	0.99	0.96	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00
10	14	0.40	1.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	28	0.10	0.53	0.11	0.32	0.47	0.13	0.35	0.50	0.16	0.40	0.54	0.19	0.44	0.59
5	28	0.25	1.32	0.77	0.96	0.99	0.90	0.99	1.00	0.96	1.00	1.00	0.99	1.00	1.00
5	28	0.40	2.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	70	0.10	0.84	0.09	0.20	0.32	0.07	0.20	0.33	0.08	0.23	0.37	0.08	0.25	0.40
2	70	0.25	2.09	0.19	0.58	0.83	0.28	0.73	0.91	0.42	0.85	0.96	0.57	0.93	0.98
2	70	0.40	3.35	0.35	0.89	0.99	0.63	0.98	1.00	0.86	1.00	1.00	0.97	1.00	1.00

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.22

POWER BASED ON 140 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	7	0.10	0.18	0.06	0.19	0.31	0.07	0.21	0.33	0.08	0.23	0.35	0.09	0.25	0.37
20	7	0.25	0.45	0.55	0.79	0.88	0.68	0.87	0.93	0.78	0.92	0.96	0.85	0.95	0.98
20	7	0.40	0.71	0.96	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	14	0.10	0.20	0.03	0.13	0.22	0.04	0.14	0.23	0.04	0.14	0.24	0.04	0.15	0.26
10	14	0.25	0.49	0.28	0.56	0.70	0.36	0.63	0.75	0.44	0.70	0.81	0.52	0.76	0.86
10	14	0.40	0.79	0.74	0.92	0.96	0.86	0.96	0.99	0.93	0.99	0.99	0.97	1.00	1.00
5	28	0.10	0.21	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17	0.02	0.10	0.18
5	28	0.25	0.52	0.11	0.31	0.46	0.13	0.34	0.49	0.16	0.39	0.54	0.19	0.43	0.58
5	28	0.40	0.84	0.32	0.65	0.79	0.42	0.73	0.84	0.53	0.80	0.89	0.63	0.86	0.93
2	70	0.10	0.22	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.03	0.07	0.13
2	70	0.25	0.54	0.07	0.14	0.22	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.23
2	70	0.40	0.87	0.09	0.20	0.33	0.08	0.21	0.35	0.08	0.24	0.39	0.09	0.27	0.43

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.23

POWER BASED ON 140 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS

AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	7	0.10	0.13	0.03	0.12	0.22	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25
20	7	0.25	0.33	0.28	0.54	0.67	0.35	0.61	0.73	0.43	0.68	0.79	0.50	0.74	0.83
20	7	0.40	0.53	0.74	0.91	0.95	0.86	0.96	0.98	0.93	0.98	0.99	0.97	0.99	1.00
10	14	0.10	0.14	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
10	14	0.25	0.34	0.11	0.31	0.44	0.13	0.34	0.48	0.16	0.38	0.52	0.19	0.42	0.56
10	14	0.40	0.55	0.36	0.65	0.77	0.46	0.7[illegible]	0.83	0.56	0.80	0.88	0.65	0.85	0.92
5	28	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	28	0.25	0.35	0.05	0.16	0.27	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.32
5	28	0.40	0.56	0.12	0.34	0.50	0.15	0.38	0.53	0.19	0.43	0.58	0.22	0.48	0.63
2	70	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	70	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	70	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.14	0.23	0.05	0.14	0.24

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.24

POWER BASED ON 140 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	7	0.10	0.11	0.02	0.10	0.18	0.02	0.10	0.19	0.02	0.11	0.19	0.03	0.11	0.20
20	7	0.25	0.27	0.18	0.40	0.54	0.21	0.45	0.59	0.26	0.51	0.64	0.31	0.56	0.69
20	7	0.40	0.44	0.54	0.78	0.87	0.66	0.86	0.92	0.76	0.91	0.95	0.84	0.95	0.97
10	14	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	14	0.25	0.28	0.07	0.22	0.34	0.08	0.23	0.36	0.09	0.26	0.38	0.11	0.28	0.41
10	14	0.40	0.44	0.22	0.47	0.62	0.27	0.53	0.67	0.33	0.60	0.73	0.40	0.66	0.78
5	28	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	28	0.25	0.28	0.03	0.12	0.21	0.03	0.12	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	28	0.40	0.45	0.08	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.43	0.12	0.32	0.46
2	70	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	70	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	70	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.25

POWER BASED ON 160 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS

AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	8	0.10	0.28	0.19	0.42	0.56	0.23	0.47	0.61	0.28	0.53	0.66	0.34	0.59	0.71
20	8	0.25	0.71	0.96	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	8	0.40	1.13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	16	0.10	0.40	0.17	0.40	0.55	0.21	0.45	0.59	0.25	0.51	0.64	0.30	0.56	0.69
10	16	0.25	1.00	0.93	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	16	0.40	1.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	32	0.10	0.57	0.13	0.35	0.51	0.16	0.39	0.55	0.19	0.45	0.60	0.24	0.50	0.64
5	32	0.25	1.41	0.83	0.97	0.99	0.94	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00
5	32	0.40	2.26	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	80	0.10	0.89	0.09	0.21	0.34	0.08	0.22	0.36	0.08	0.25	0.40	0.09	0.28	0.44
2	80	0.25	2.24	0.21	0.62	0.87	0.32	0.78	0.94	0.48	0.89	0.98	0.65	0.96	0.99
2	80	0.40	3.58	0.39	0.93	1.00	0.69	0.99	1.00	0.91	1.00	1.00	0.98	1.00	1.00

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.26

POWER BASED ON 160 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
	SIZE	ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	8	0.10	0.18	0.06	0.20	0.32	0.07	0.22	0.34	0.08	0.24	0.36	0.09	0.26	0.39
20	8	0.25	0.46	0.58	0.81	0.89	0.70	0.88	0.94	0.80	0.93	0.97	0.87	0.96	0.98
20	8	0.40	0.73	0.97	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1,00	1.00	1.00
10	16	0.10	0.20	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25	0.04	0.16	0.26
10	16	0.25	0.50	0.29	0.57	0.71	0.37	0.64	0.76	0.45	0.71	0.82	0.54	0.78	0.87
10	16	0.40	0.80	0.75	0.93	0.97	0.87	0.97	0.99	0.94	0.99	1.00	0.97	1.00	1.00
5	32	0.10	0.21	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17	0.02	0.10	0.18
5	32	0.25	0.53	0.11	0.32	0.46	0.13	0.35	0.50	0.16	0.39	0.54	0.19	0.44	0.59
5	32	0.40	0.84	0.33	0.65	0.79	0.43	0.73	0.85	0.54	0.81	0.90	0.64	0.87	0.93
2	80	0.10	0.22	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.03	0.07	0.13
2	80	0.25	0.55	0.07	0.14	0.22	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.23
2	80	0.40	0.87	0.09	0.20	0.33	0.08	0.21	0.35	0.08	0.24	0.39	0.09	0.27	0.43

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.27

POWER BASED ON 160 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT[1]	EFFECT	SIZE[2]	2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
	SIZE	ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	8	0.10	0.13	0.03	0.12	0.22	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25
20	8	0.25	0.33	0.29	0.55	0.68	0.36	0.62	0.74	0.44	0.69	0.79	0.51	0.75	0.84
20	8	0.40	0.53	0.75	0.91	0.96	0.86	0.96	0.98	0.93	0.98	0.99	0.97	0.99	1.00
10	16	0.10	0.14	0.02	0.08	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
10	16	0.25	0.34	0.11	0.31	0.45	0.14	0.34	0.48	0.16	0.38	0.52	0.19	0.43	0.56
10	16	0.40	0.55	0.37	0.65	0.77	0.46	0.73	0.83	0.56	0.80	0.88	0.65	0.86	0.92
5	32	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	32	0.25	0.35	0.05	0.16	0.27	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.32
5	32	0.40	0.56	0.12	0.35	0.50	0.15	0.38	0.53	0.19	0.43	0.58	0.23	0.49	0.63
2	80	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	80	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	80	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.14	0.23	0.05	0.14	0.24

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.28

POWER BASED ON 160 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	8	0.10	0.11	0.02	0.10	0.18	0.02	0.10	0.19	0.02	0.11	0.19	0.03	0.11	0.20
20	8	0.25	0.28	0.18	0.40	0.54	0.22	0.45	0.59	0.26	0.51	0.64	0.31	0.56	0.69
20	8	0.40	0.44	0.54	0.78	0.87	0.66	0.86	0.92	0.76	0.91	0.95	0.84	0.95	0.97
10	16	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	16	0.25	0.28	0.07	0.22	0.34	0.08	0.23	0.36	0.09	0.26	0.39	0.11	0.28	0.41
10	16	0.40	0.44	0.22	0.48	0.62	0.27	0.53	0.67	0.34	0.60	0.73	0.40	0.66	0.78
5	32	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	32	0.25	0.28	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	32	0.40	0.45	0.08	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.43	0.12	0.32	0.46
2	80	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	80	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	80	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.29

POWER BASED ON 200 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	10	0.10	0.32	0.25	0.51	0.64	0.31	0.57	0.70	0.38	0.64	0.75	0.45	0.70	0.80
20	10	0.25	0.79	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	10	0.40	1.26	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	20	0.10	0.45	0.22	0.48	0.62	0.28	0.54	0.68	0.34	0.61	0.73	0.41	0.67	0.78
10	20	0.25	1.12	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	20	0.40	1.79	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	40	0.10	0.63	0.17	0.43	0.58	0.21	0.48	0.63	0.26	0.54	0.69	0.32	0.60	0.74
5	40	0.25	1.58	0.91	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	40	0.40	2.53	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	100	0.10	1.00	0.10	0.23	0.39	0.09	0.26	0.42	0.10	0.30	0.47	0.12	0.34	0.52
2	100	0.25	2.50	0.24	0.70	0.92	0.39	0.86	0.97	0.59	0.95	0.99	0.76	0.98	1.00
2	100	0.40	4.00	0.45	0.96	1.00	0.79	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.30

POWER BASED ON 200 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	EFFECT SIZE[2] UNIT	2 LEVELS / ALPHA .01	2 LEVELS / ALPHA .05	2 LEVELS / ALPHA .10	3 LEVELS / ALPHA .01	3 LEVELS / ALPHA .05	3 LEVELS / ALPHA .10	4 LEVELS / ALPHA .01	4 LEVELS / ALPHA .05	4 LEVELS / ALPHA .10	5 LEVELS / ALPHA .01	5 LEVELS / ALPHA .05	5 LEVELS / ALPHA .10
20	10	0.10	0.19	0.07	0.21	0.33	0.08	0.23	0.35	0.09	0.25	0.38	0.10	0.28	0.41
20	10	0.25	0.47	0.62	0.84	0.91	0.74	0.90	0.95	0.84	0.95	0.97	0.90	0.97	0.99
20	10	0.40	0.76	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	20	0.10	0.20	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.26	0.05	0.16	0.27
10	20	0.25	0.51	0.31	0.59	0.72	0.39	0.66	0.78	0.48	0.73	0.83	0.56	0.80	0.88
10	20	0.40	0.82	0.77	0.94	0.97	0.89	0.97	0.99	0.95	0.99	1.00	0.98	1.00	1.00
5	40	0.10	0.21	0.02	0.09	0.17	0.02	0.09	0.17	0.02	0.10	0.17	0.02	0.10	0.18
5	40	0.25	0.53	0.11	0.32	0.47	0.13	0.36	0.50	0.17	0.40	0.55	0.20	0.45	0.59
5	40	0.40	0.85	0.34	0.66	0.80	0.44	0.74	0.86	0.55	0.82	0.91	0.65	0.88	0.94
2	100	0.10	0.22	0.06	0.10	0.14	0.04	0.08	0.13	0.03	0.08	0.13	0.03	0.07	0.13
2	100	0.25	0.55	0.07	0.14	0.22	0.05	0.13	0.21	0.05	0.13	0.22	0.04	0.14	0.24
2	100	0.40	0.88	0.09	0.20	0.33	0.08	0.21	0.35	0.08	0.24	0.39	0.09	0.27	0.43

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.31

POWER BASED ON 200 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
	SIZE	ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	10	0.10	0.13	0.03	0.13	0.22	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25
20	10	0.25	0.34	0.30	0.56	0.69	0.37	0.63	0.75	0.45	0.70	0.80	0.53	0.76	0.85
20	10	0.40	0.54	0.76	0.92	0.96	0.87	0.96	0.98	0.94	0.99	0.99	0.97	0.99	1.00
10	20	0.10	0.14	0.02	0.03	0.16	0.02	0.09	0.16	0.02	0.09	0.17	0.02	0.09	0.17
10	20	0.25	0.35	0.12	0.31	0.45	0.14	0.35	0.48	0.17	0.39	0.53	0.20	0.43	0.57
10	20	0.40	0.55	0.37	0.66	0.78	0.47	0.73	0.84	0.57	0.80	0.89	0.66	0.86	0.92
5	40	0.10	0.14	0.01	0.06	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	40	0.25	0.35	0.05	0.16	0.27	0.05	0.17	0.28	0.06	0.19	0.30	0.06	0.20	0.32
5	40	0.40	0.56	0.12	0.35	0.50	0.15	0.39	0.54	0.19	0.44	0.59	0.23	0.49	0.63
2	100	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	100	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	100	0.40	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.14	0.23	0.05	0.14	0.24

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.32

POWER BASED ON 200 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	EFFECT SIZE UNIT	2 LEVELS / ALPHA .01	.05	.10	3 LEVELS / ALPHA .01	.05	.10	4 LEVELS / ALPHA .01	.05	.10	5 LEVELS / ALPHA .01	.05	.10
20	10	0.10	0.11	0.02	0.10	0.18	0.02	0.10	0.19	0.02	0.11	0.19	0.03	0.11	0.20
20	10	0.25	0.28	0.18	0.41	0.54	0.22	0.45	0.59	0.27	0.51	0.64	0.31	0.56	0.69
20	10	0.40	0.44	0.54	0.79	0.87	0.66	0.86	0.92	0.77	0.92	0.96	0.84	0.95	0.98
10	20	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	20	0.25	0.28	0.07	0.22	0.34	0.08	0.23	0.36	0.09	0.26	0.39	0.11	0.29	0.41
10	20	0.40	0.44	0.22	0.48	0.62	0.27	0.54	0.67	0.34	0.60	0.73	0.40	0.66	0.78
5	40	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	40	0.25	0.28	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	40	0.40	0.45	0.08	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.43	0.12	0.32	0.46
2	100	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	100	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	100	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.33

POWER BASED ON 1000 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.0

UNITS	UNIT SIZE[1]	EFFECT SIZE[2] ENTITY	EFFECT SIZE[2] UNIT	2 LEVELS / ALPHA .01	2 LEVELS / ALPHA .05	2 LEVELS / ALPHA .10	3 LEVELS / ALPHA .01	3 LEVELS / ALPHA .05	3 LEVELS / ALPHA .10	4 LEVELS / ALPHA .01	4 LEVELS / ALPHA .05	4 LEVELS / ALPHA .10	5 LEVELS / ALPHA .01	5 LEVELS / ALPHA .05	5 LEVELS / ALPHA .10
20	50	0.10	0.71	0.96	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	50	0.25	1.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	50	0.40	2.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	100	0.10	1.00	0.93	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	100	0.25	2.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	100	0.40	4.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	200	0.10	1.41	0.83	0.97	0.99	0.94	0.99	1.00	0.98	1.00	1.00	1.00	1.00	1.00
5	200	0.25	3.54	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	200	0.40	5.66	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	500	0.10	2.24	0.21	0.62	0.87	0.32	0.78	0.94	0.48	0.89	0.98	0.65	0.96	0.99
2	500	0.25	5.59	0.70	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	500	0.40	8.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.34

POWER BASED ON 1000 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	50	0.10	0.22	0.09	0.27	0.39	0.11	0.29	0.42	0.13	0.32	0.46	0.15	0.36	0.49
20	50	0.25	0.54	0.76	0.92	0.96	0.87	0.96	0.98	0.94	0.99	0.99	0.97	0.99	1.00
20	50	0.40	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	100	0.10	0.22	0.04	0.15	0.25	0.04	0.16	0.26	0.05	0.17	0.28	0.06	0.19	0.30
10	100	0.25	0.55	0.36	0.65	0.77	0.46	0.73	0.83	0.56	0.80	0.88	0.65	0.86	0.92
10	100	0.40	0.88	0.84	0.96	0.98	0.93	0.99	1.00	0.98	1.00	1.00	0.99	1.00	1.00
5	200	0.10	0.22	0.02	0.09	0.17	0.02	0.10	0.18	0.02	0.10	0.18	0.03	0.10	0.19
5	200	0.25	0.55	0.12	0.34	0.49	0.15	0.38	0.53	0.18	0.43	0.58	0.22	0.48	0.63
5	200	0.40	0.89	0.37	0.70	0.83	0.48	0.78	0.88	0.60	0.85	0.92	0.70	0.90	0.95
2	500	0.10	0.22	0.06	0.10	0.14	0.04	0.08	0.14	0.03	0.08	0.13	0.03	0.07	0.13
2	500	0.25	0.56	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.13	0.23	0.05	0.14	0.24
2	500	0.40	0.89	0.09	0.21	0.34	0.08	0.22	0.36	0.08	0.25	0.40	0.09	0.28	0.44

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.35

POWER BASED ON 1000 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.50

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	50	0.10	0.14	0.03	0.13	0.23	0.04	0.14	0.24	0.04	0.15	0.25	0.05	0.16	0.27
20	50	0.25	0.35	0.32	0.59	0.72	0.40	0.66	0.77	0.49	0.73	0.83	0.57	0.79	0.87
20	50	0.40	0.56	0.80	0.94	0.97	0.90	0.97	0.99	0.96	0.99	1.00	0.98	1.00	1.00
10	100	0.10	0.14	0.02	0.08	0.16	0.02	0.09	0.17	0.02	0.09	0.17	0.02	0.10	0.18
10	100	0.25	0.35	0.12	0.32	0.46	0.15	0.36	0.50	0.18	0.40	0.54	0.21	0.45	0.58
10	100	0.40	0.56	0.39	0.67	0.79	0.49	0.75	0.85	0.59	0.82	0.90	0.68	0.88	0.93
5	200	0.10	0.14	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13	0.01	0.07	0.13
5	200	0.25	0.35	0.05	0.17	0.28	0.05	0.18	0.29	0.06	0.19	0.31	0.07	0.21	0.33
5	200	0.40	0.56	0.13	0.35	0.51	0.16	0.39	0.54	0.19	0.45	0.59	0.23	0.50	0.64
2	500	0.10	0.14	0.06	0.09	0.14	0.04	0.08	0.13	0.03	0.07	0.12	0.02	0.07	0.12
2	500	0.25	0.35	0.06	0.11	0.17	0.04	0.10	0.16	0.03	0.09	0.16	0.03	0.09	0.16
2	500	0.40	0.57	0.07	0.14	0.22	0.05	0.13	0.22	0.05	0.14	0.23	0.05	0.14	0.24

[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

TABLE 4.3.36

POWER BASED ON 1000 ENTITIES WHEN GROUP MEAN IS THE UNIT OF ANALYSIS AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.80

UNITS	UNIT SIZE[1]	EFFECT SIZE[2]		2 LEVELS / ALPHA			3 LEVELS / ALPHA			4 LEVELS / ALPHA			5 LEVELS / ALPHA		
		ENTITY	UNIT	.01	.05	.10	.01	.05	.10	.01	.05	.10	.01	.05	.10
20	50	0.10	0.11	0.02	0.10	0.18	0.02	0.10	0.19	0.03	0.11	0.20	0.03	0.12	0.20
20	50	0.25	0.28	0.18	0.41	0.55	0.22	0.46	0.60	0.27	0.52	0.65	0.32	0.57	0.70
20	50	0.40	0.45	0.55	0.79	0.88	0.68	0.87	0.93	0.78	0.92	0.96	0.85	0.95	0.98
10	100	0.10	0.11	0.01	0.07	0.14	0.01	0.07	0.14	0.01	0.07	0.14	0.02	0.08	0.15
10	100	0.25	0.28	0.07	0.22	0.34	0.08	0.24	0.36	0.09	0.26	0.39	0.11	0.29	0.42
10	100	0.40	0.45	0.22	0.48	0.62	0.28	0.54	0.68	0.34	0.61	0.73	0.41	0.67	0.78
5	200	0.10	0.11	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12	0.01	0.06	0.12
5	200	0.25	0.28	0.03	0.12	0.21	0.03	0.13	0.22	0.04	0.13	0.23	0.04	0.14	0.24
5	200	0.40	0.45	0.08	0.24	0.37	0.09	0.26	0.39	0.10	0.29	0.43	0.12	0.32	0.46
2	500	0.10	0.11	0.06	0.09	0.13	0.04	0.08	0.12	0.03	0.07	0.12	0.02	0.07	0.12
2	500	0.25	0.28	0.06	0.10	0.15	0.04	0.09	0.14	0.03	0.08	0.14	0.03	0.08	0.14
2	500	0.40	0.45	0.07	0.12	0.19	0.05	0.11	0.18	0.04	0.11	0.19	0.04	0.11	0.19

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[1] UNIT SIZE IS THE NUMBER OF ENTITIES PER UNIT.

[2] THE ENTITY EFFECT SIZE IS THE EFFECT SIZE IF EACH ENTITY SERVED AS THE UNIT OF ANALYSIS.

APPENDIX 3

The Monte Carlo Program (VIOL) that Estimates the Actual Level of Significance When the Independence Assumption Among Entities is Violated

C.1. Introduction

This Appendix contains a listing of the Monte Carlo computer program, "VIOL", used to estimate the actual level of significance when the independence assumption among entities is violated. The input for and output, Table 4.4.1, from VIOL are also given. Soon after this program was written (it is a modification of program MBAR) an article by Walsh (1947) was found that indicated that the actual level of significance for a constant measure of interrelationship among individuals could be found using

$$F_\alpha = F_\varepsilon \frac{(1 - \rho)}{(1 + (n-1)\rho)}.$$

In this equation F_α is Fisher's F when ρ is the interrelationship among each pair of n entities in a cell of an ANOVA design, and F_ε is Fisher's F for the nominal level of significance. To find the actual level of significance one finds the probability of finding an F value larger than or equal to F_α. This assumes that n and ρ are constant across treatment levels, as does the program VIOL. Table 1.1.1 in Section 1 was generated using Walsh's procedure for two treatment levels when $\alpha = .05$. Note that the Monte Carlo procedure output in Table 4.4.1 yields a column of comparable results. In all cases when $\rho > 0$ the results unequivocally indicate that the probability of making a type II error is seriously high.

```
C-----------------------------------------------------------------------VIOL0001
C   PROGRAM VIOL WAS WRITTEN BY                                         VIOL0002
C   ROBERT S. BARCIKOWSKI                                               VIOL0003
C   AT OHIO UNIVERSITY                                                  VIOL0004
C   FUNDING FOR VIOL WAS PROVIDED BY THE NATIONAL INSTITUTE OF EDUCATION.VIOL0005
C   GRANT NUMBER:  NIE-G-78-0072                                        VIOL0006
C   GRANT TITLE:  STATISTICAL POWER WITH GROUP                          VIOL0007
C                 MEAN AS THE UNIT OF ANALYSIS                          VIOL0008
C   FUNDING PERIOD:  1978 - 1980                                        VIOL0009
C-----------------------------------------------------------------------VIOL0010
C   VIOL COMPUTES THE LEVEL OF SIGNIFICANCE FOR A ONE-WAY ANALYSIS OF   VIOL0011
C   VARIANCE WHEN THE ENTITIES (SUBJECTS) ARE RELATED.                  VIOL0012
C-----------------------------------------------------------------------VIOL0013
C-----------------------------------------------------------------------VIOL0014
C   CARD 1                                                              VIOL0015
C-----------------------------------------------------------------------VIOL0016
C       COLUMNS                                                         VIOL0017
C        1 - 80        ANY LABEL                                        VIOL0018
C-----------------------------------------------------------------------VIOL0019
C   CARD 2                                                              VIOL0020
C-----------------------------------------------------------------------VIOL0021
C       COLUMNS                                                         VIOL0022
C        1 - 80        ANY LABEL                                        VIOL0023
C-----------------------------------------------------------------------VIOL0024
C   CARD 3                                                              VIOL0025
C-----------------------------------------------------------------------VIOL0026
C       COLUMNS                                                         VIOL0027
C        1 - 9         ISEED = SEED VALUE FOR THE RANDOM NUMBER         VIOL0028
C                      GENERATOR (ODD NUMBER)                           VIOL0029
C                                                                       VIOL0030
C       10 - 13        ISUB = NUMBER OF ENTITY SIZES TO BE READ         VIOL0031
C                      (20 MAXIMUM)                                     VIOL0032
C                                                                       VIOL0033
C       14 - 17        LEVEL1 = INITIAL NUMBER OF TREATMENT LEVELS      VIOL0034
C                      (GREATER THEN ONE)                               VIOL0035
C                                                                       VIOL0036
C       18 - 21        LEVEL2 = TERMINAL NUMBER OF TREATMENT LEVELS     VIOL0037
C                                                                       VIOL0038
C       22 - 25        IREP = NUMBER OF REPLICATIONS FOR EACH POWER VALUE VIOL0039
C                                                                       VIOL0040
C       26 - 29        ISUBR = NUMBER SENT TO SUBROUTINE CORR           VIOL0041
C                      THAT INDICATES WHETHER THE CORRELATION           VIOL0042
C                      MATRICES ARE TO BE READ IN OR CREATED :          VIOL0043
C                      1 = READ, 2 = CREATED.                           VIOL0044
C                      SEE SUBROUTINE CORR FOR CARDS WHEN ISUBR = 1.    VIOL0045
C                                                                       VIOL0046
C       30 - 33        ICORR = NUMBER OF OFF DIAGONAL CORRELATIONS IF   VIOL0047
C                      ISUBR = 2.  (20 MAXIMUM)                         VIOL0048
C                      ICORR = NUMBER OF CORRELATION MATRICES TO BE READ VIOL0049
C                      IF ISUBR = 1.  (NO LIMIT)                        VIOL0050
C                                                                       VIOL0051
C-----------------------------------------------------------------------VIOL0052
C   CARD 4                                                              VIOL0053
C-----------------------------------------------------------------------VIOL0054
C       COLUMNS                                                         VIOL0055
C        1 - 4         NUMBER OF ENTITIES PER TREATMENT -- READ BY (15I4) VIOL0056
C                      *** IMPORTANT *** THE LARGEST NUMBER OF ENTITIES. VIOL0057
C                      MUST BE ORDERED LAST AND MAY NOT EXCEED 200.     VIOL0058
C                      MAXIMUM OF 15                                    VIOL0059
C        5 - 8                                                          VIOL0060
```

```
C      ETC.
C     77 - 80
C-----------------------------------------------------------------------
C CARD 5    (THIS CARD WOULD BE SKIPPED IF ISUBR = 1)
C-----------------------------------------------------------------------
C     COLUMNS
C      1 - 4           CORRELATION VALUES FOR CREATED MATRICES
C                      -- READ BY (20F4.0)
C                      MAXIMUM OF 20
C      5 - 8
C      ETC.
C     77 - 80
C-----------------------------------------------------------------------
C  CARD 6
C-----------------------------------------------------------------------
C      1 - 4           TABLE IDENTIFICATION NUMBER -- READ BY (20A4)
C                      MAXIMUM OF 100 TABLES
C      5 - 8
C      ETC.
C     77 - 80
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C  LIMITATIONS:
C-----------------------------------------------------------------------
C  PROGRAM IS DIMENSIONED FOR A MAXIMUM OF 200 ENTITIES PER CELL
C  THE NUMBER OF CELLS SHOULD NOT EXCEED 5.
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
      DIMENSION WTV(5),S(3),NDF(3),Z(200),Y(1000),NOGP(5),TM(5),
     >  LABEL(40),NSUB(15),R(20),POW1(5),POW2(5),POW3(5),ESCAL(5),
     >  ITABLE(20)
      COMMON /SUB1/ISUBR,A(200,200),TRIA(200,200),COR,NSG
C
C  PROGRAM AVOL IS A MODIFICATION OF PROGRAM RPOW.  THEREFORE,
C  COMMENTS ON AVOL'S FORTRAN STATEMENTS MAY BE FOUND IN THE LISTING OF
C  RPOW.
C
C  THE MAIN DIFFERENCE BETWEEN AVOL AND RPOW IS THAT THE GROUP
C  AND EFFECT SIZES DO LOOPS WERE REMOVED FROM RPOW
C
      READ 1,LABEL
    1 FORMAT(20A4)
      PRINT 2,LABEL
    2 FORMAT(1H1,(20A4))
      READ 3,ISEED,ISUB,LEVEL1,LEVEL2,IREP,ISUBR,ICORR
    3 FORMAT(I9,6I4)
      PRINT 4,ISEED,ISUB,LEVEL1,LEVEL2,IREP,ISUBR,ICORR
    4 FORMAT(1H0,'THE SEED VALUE IS',I15,//,' NUMBER OF DIFFERENT ',
     >  'SAMPLE SIZES',I5//,' INITIAL NUMBER OF LEVELS',I5,//,
     >  ' TERMINAL NUMBER OF LEVELS',I5//,' NUMBER OF REPLICATIONS',I6,/
     >  /' SUBROUTINE VALUE IS',I3,10X,'* 1 = READ, 2 = CREATE *',//,
     >  ' NUMBER OF CORRELATIONAL VALUES',I3)
      CALL INTGEN(ISEED)
      READ 5,(NSUB(I),I=1,ISUB)
    5 FORMAT(15I4)
      PRINT 6,(NSUB(I),I=1,ISUB)
    6 FORMAT('0CELL SAMPLE SIZES',/(15I6))
      IF(ISUBR.EQ.1) GO TO 9
      READ 7,(R(I),I=1,ICORR)
    7 FORMAT(20F4.0)
```

```
      PRINT 8.(R(I).I=1.ICORR)
    8 FORMAT('0CORRELATIONS FOR CREATED MATRICES'./(20F6.2))
    9 READ 1.(ITABLE(I).I=1.ICORR)
      PRINT 10.(ITABLE(I).I=1.ICORR)
   10 FORMAT('0THE TABLES TO BE PRINTED ARE :'.20A4)
      RES = 0.0
      ENTES = 0.0
      UNITES = 0.0
      DO 28 J=1.ICORR
      COR = R(J)
      NSG = NSUB(ISUB)
      CALL CORR
      PRINT 11.ITABLE(J).COR.IREP
   11 FORMAT(1H1.////.T57.'TABLE'.A4/.1H0.T33.'ESTIMATED ALPHA WHEN '.
     >  'THE INDEPENDENCE ASSUMPTION IS VIOLATED AND'/.1H0.T38.
     >  'THE CORRELATION BETWEEN THE UNIT MEMBERS IS'.F5.2.':'/.1H0.T50.
     >  'BASED ON'.I5.' REPLICATIONS')
      PRINT 12
   12 FORMAT(1H0.21('------'))
      PRINT 13
   13 FORMAT(1H0.'UNITS'.T9.'UNIT'.T16.'EFFECT SIZE'.T30.'2 LEVELS / '.
     >  'ALPHA'.T48.'EFFECT'.T56.'3 LEVELS / ALPHA'.T74.'EFFECT'.T82.
     >  '4 LEVELS / ALPHA'.T100.'EFFECT'.T108.'5 LEVELS / ALPHA'/.T9.
     >  'SIZE'.T15.'ENT UNIT  EST'.T32.'.01   .05   .10'.T49.'SIZE'.T58.
     >  '.01   .05   .10'.T75.'SIZE'.T84.'.01   .05   .10'.T101.'SIZE'.T110.
     >  '.01   .05   .10')
      NSG = 1
      PRINT 12
      DO 27 I=1.ISUB
      N = NSUB(I)
      RN = N
C-----------------------------------------------------------------------
C   PRINT STATEMENTS THAT WERE MADE INTO COMMENT STATEMENTS MAY
C   BE USED. BY DELETING THE C IN THE FIRST COLUMN. TO CHECK
C   ON THE CALCULATIONS IN THIS PROGRAM.
C
C     PRINT 1000.N.I.ISUB.RN
C1000 FORMAT(3I7.F8.4)
C-----------------------------------------------------------------------
      DO 25 L=LEVEL1.LEVEL2
      RL = L
      DO 14 LH=1.L
      NOGP(LH) = N
   14 CONTINUE
      D1 = RL-1.0
      D2 = RL*(RN-1.)
      ESCAL(L) = 0.0
      POW1(L) = 0.0
      POW2(L) = 0.0
      POW3(L) = 0.0
      CALL MDFI(.99.D1.D2.REJ1.IER)
      CALL MDFI(.95.D1.D2.REJ2.IER)
      CALL MDFI(.90.D1.D2.REJ3.IER)
C     PRINT 1004. L.        D1.D2.POW1(L).POW2(L).POW3(L).REJ1.REJ2.REJ3
C    <.D1.D2.IER
C1004 FORMAT(I5.10F7.2.I5)
      DO 24 N1=1.IREP
      REP = IREP
      JM = 0
      DO 17 J1=1.L
      DO 16 I1=1.N                                                      VIOL0181
      JM = JM+1                                                         VIOL0182
      Z(I1) = ANORM(T)                                                  VIOL0183
      X = 0.0                                                           VIOL0184
      DO 15 L1=1.I1                                                     VIOL0185
      X = X+TRIA(I1.L1)*Z(L1)                                           VIOL0186
   15 CONTINUE                                                          VIOL0187
      Y(JM) = X                                                         VIOL0188
   16 CONTINUE                                                          VIOL0189
   17 CONTINUE                                                          VIOL0190
      CALL ACRDAN(Y.L.NUGP.TM.WTV.S.GM.NDF.IER)                         VIOL0191
      DF1 = NDF(1)                                                      VIOL0192
      DF2 = NDF(2)                                                      VIOL0193
      ERRT = S(2)/DF2                                                   VIOL0194
      FCAL = (S(1)/DF1)/ERRT                                            VIOL0195
      SM = 0.0                                                          VIOL0196
      DO 18 L2=1.L                                                      VIOL0197
      SM = (TM(L2)-GM)**2+SM                                            VIOL0198
   18 CONTINUE                                                          VIOL0199
      SM = SQRT(SM/RL)                                                  VIOL0200
      ERRT = SQRT(ERRT)                                                 VIOL0201
      ESCAL(L) = SM/ERRT+ESCAL(L)                                       VIOL0202
      IF(REJ1-FCAL) 19.19.20                                            VIOL0203
   19 POW1(L) = POW1(L)+1.0                                             VIOL0204
      POW2(L) = POW2(L)+1.0                                             VIOL0205
      POW3(L) = POW3(L)+1.0                                             VIOL0206
      GO TO 24                                                          VIOL0207
   20 IF(REJ2-FCAL) 21.21.22                                            VIOL0208
   21 POW2(L) = POW2(L)+1.0                                             VIOL0209
      POW3(L) = POW3(L)+1.0                                             VIOL0210
      GO TO 24                                                          VIOL0211
   22 IF(REJ3-FCAL) 23.23.24                                            VIOL0212
   23 POW3(L) = POW3(L)+1.0                                             VIOL0213
   24 CONTINUE                                                          VIOL0214
C   *****  THE PRECEDING CARD MUST BE REMOVED WHEN THE FOLLOWING PRINT ISVIOL0215
C24   PRINT 1008.L.POW1(L).POW2(L).POW3(L).FCAL.REJ1.REJ2.REJ3          VIOL0216
C1008 FORMAT(I5.7F8.3)                                                  VIOL0217
      ESCAL(L) = ESCAL(L)/REP                                           VIOL0218
      POW1(L) = POW1(L)/REP                                             VIOL0219
      POW2(L) = POW2(L)/REP                                             VIOL0220
      POW3(L) = POW3(L)/REP                                             VIOL0221
   25 CONTINUE                                                          VIOL0222
      PRINT 26.N.NSG.ENTES.UNITES.(ESCAL(L).POW1(L).POW2(L).POW3(L).    VIOL0223
     >  L=LEVEL1.LEVEL2)                                                VIOL0224
   26 FORMAT(1H0.I4.T9.I3.T14.2(F4.2.'/').F5.2.T30.3F5.2.T48.F6.2.T56.  VIOL0225
     >  3F5.2.T74.F6.2.T82.3F5.2.T100.F6.2.T108.3F5.2)                  VIOL0226
   27 CONTINUE                                                          VIOL0227
      PRINT 12                                                          VIOL0228
   28 CONTINUE                                                          VIOL0229
      STOP                                                              VIOL0230
      END                                                               VIOL0231
      SUBROUTINE CORR                                                   VIOL0001
      COMMON /SUB1/ISUB.A(200.200).TRIA(200.200).COR.NV                 VIOL0002
      DIMENSION VFMT(20)                                                VIOL0003
      GO TO (1.4).ISUB                                                  VIOL0004
C-----------------------------------------------------------------------VIOL0005
C   IF ISUBR = 1 IN THE MAIN PROGRAM, THEN, FOLLOWING THE LAST          VIOL0006
C   TABLE NUMBERS CARD SHOULD BE:                                       VIOL0007
C   1)  A FORMAT CARD FOR THE CORRELATION MATRIX TO BE READ IN          VIOL0008
C   2) THE CORRELATION MATRIX TO BE READ BY THE PRECEDING FORMAT CARD   VIOL0009
```

```
    1 READ 2.VFMT
    2 FORMAT(20A4)
      DO 3 I=1.NV
      READ VFMT.(A(I.J).J=1.NV)
    3 CONTINUE
C-------------------------------------------------------------------------
      GO TO 7
    4 DO 6 I=1.NV
      DO 5 J=1.NV
    5 A(I.J) = COR
      A(I.I) = 1.0
    6 CONTINUE
    7 CONTINUE
C
C   A IS THE POPULATION CORRELATION MATRIX
C
C     PRINT 17
C  17 FORMAT('0THE POPULATION CORRELATION MATRIX'/)
C     DO 6 I = 1.NV
C   6 PRINT 18.(A(I.J).J=1.NV)
C  18 FORMAT(12F10.6/12F10.6/)
C-------------------------------------------------------------------------
C   CHOLESKY (SQUARE ROOT FACTORING) DECOMPOSITION OF THE
C   POPULATION CORRELATION MATRIX.  SEE FINN. J.D. A GENERAL
C   MODEL FOR MULTIVARIATE ANALYSIS.  NEW YORK:  HOLT. RINEHART
C   AND WINSTON. 1974. PP. 37 - 39.
C-------------------------------------------------------------------------
      DO 8 J=1.NV
      DO 8 I=1.NV
      TRIA(I.J) = 0.0
    8 CONTINUE
      TRIA(1.1) = A(1.1)**.5
      DO 9 I=2.NV
      TRIA(I.1) = A(I.1)/TRIA(1.1)
    9 CONTINUE
      DO 13 J=2.NV
      TSQ = 0.0
      JJ = J-1
      DO 10 K=1.JJ
      TSQ = TSQ+TRIA(J.K)*TRIA(J.K)
   10 CONTINUE
      TRIA(J.J) = (A(J.J)-TSQ)**.5
      X = TRIA(J.J)
      IIJ = J+1
      IF(IIJ.GT.NV) GO TO 13
      DO 12 II=IIJ.NV
      TJKTJK = 0.0
      DO 11 KK=1.JJ
      TJKTJK = TJKTJK+TRIA(II.KK)*TRIA(J.KK)
   11 CONTINUE
      TRIA(II.J) = (A(II.J)-TJKTJK)/X
   12 CONTINUE
   13 CONTINUE
C     DO 27 I = 1.NV
C27   PRINT 18.(TRIA(I.J).J=1.I)
      RETURN
      END
```

```
*
 EXECUTION TIME FOR VIOL ON AN IBM 370 WAS 7 MIN. 46.10 SEC.
```

```
*
  THE FOLLOWING CARD INPUT GENERATED THE PROGRAM OUTPUT ON THE
  FOLLOWING PAGE AND TABLE 4.4.1
*
  THE FIRST AND LAST TWO CARDS SERVE TO IDENTIFY COLUMNS AND
  ARE NOT PART OF THE CARD INPUT
*

00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890

  FINAL RUN AVGL
  WHITE PAPER
783689289   3   2  51000   2   1
  10  25  40
 .20

00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

← The single table identification card was left blank so that the table could be numbered on a typewriter.

```
  FINAL RUN AVUL
 WHITE PAPER

THE SEED VALUE IS       783689269

NUMBER OF DIFFERENT SAMPLE SIZES    3

INITIAL NUMBER OF LEVELS    2

TERMINAL NUMBER OF LEVELS    5

NUMBER OF REPLICATIONS  1000

SUBROUTINE VALUE IS  2           * 1 = READ. 2 = CREATE *

NUMBER OF CORRELATIONAL VALUES  1

CELL SAMPLE SIZES
   10    25    40

CORRELATIONS FOR CREATED MATRICES
 0.20

THE TABLES TO BE PRINTED ARE :
```

TABLE 4.4.1

ESTIMATED ALPHA WHEN THE INDEPENDENCE ASSUMPTION IS VIOLATED AND THE CORRELATION BETWEEN THE UNIT MEMBERS IS 0.20: BASED ON 1000 REPLICATIONS

UNITS	UNIT SIZE	EFFECT SIZE ENT UNIT EST	2 LEVELS / ALPHA			EFFECT SIZE	3 LEVELS / ALPHA			EFFECT SIZE	4 LEVELS / ALPHA			EFFECT SIZE	5 LEVELS / ALPHA		
			.01	.05	.10		.01	.05	.10		.01	.05	.10		.01	.05	.10
10	1	0.0 /0.0 / 0.34	0.14	0.26	0.35	0.43	0.20	0.38	0.48	0.50	0.33	0.54	0.64	0.51	0.39	0.59	0.68
25	1	0.0 /0.0 / 0.31	0.34	0.47	0.54	0.39	0.49	0.64	0.70	0.43	0.64	0.77	0.82	0.47	0.75	0.87	0.90
40	1	0.0 /0.0 / 0.29	0.42	0.53	0.61	0.37	0.63	0.73	0.78	0.42	0.79	0.87	0.90	0.44	0.87	0.93	0.96

APPENDIX 4

The Mathematical Program (R1PO) Used to Generate Power Tables For a Given Number of Entities and Units; Used Here to Calculate Power When $\rho = .20$ Across Given Parameters

D.1. Introduction

This Appendix contains a listing of, and card input for, the program R1PO which was used to generate Tables 4.5.1 through 4.5.36. In these tables the interrelationship among entities in a group was set at .20 (see subsection 3.3) and other parameters were specified as follows:

a) Level of significance (α) = .01, .05, .10,

b) Entity effect size (f) = .10, .25, .40,

c) Number of groups (units) = 2(1) 10, 12, 15, 20, 25, 30, 40, 50, 100, 200, 500, 1000,

d) Number of entities per group = 1, 2(2) 20, 20(5) 50, 50(10) 100, 100(100) 500, 1000,

e) Treatment levels = 2(1) 5.

```
C-----------------------------------------------------------------------R1P00001
C   PROGRAM R1PO WAS WRITTEN BY ROBERT S. BARCIKOWSKI                   R1P00002
C   AT OHIO UNIVERSITY                                                  R1P00003
C   FUNDING FOR R1PO WAS PROVIDED BY THE NATIONAL INSTITUTE OF EDUCATION.R1P00004
C   GRANT NUMBER:  NIE-G-78-0072                                        R1P00005
C-----------------------------------------------------------------------R1P00006
C   GRANT TITLE:  STATISTICAL POWER WITH GROUP                          R1P00007
C                 MEAN AS THE UNIT OF ANALYSIS                          R1P00008
C   FUNDING PERIOD:  1978 - 1980                                        R1P00009
C-----------------------------------------------------------------------R1P00010
C   R1PO IS A MATHEMATICAL PROGRAM THAT COMPUTES POWER VALUES           R1P00011
C   FOR A ONE-WAY ANALYSIS OF VARIANCE WHEN GROUP MEAN IS THE           R1P00012
C   UNIT OF ANALYSIS, AND THERE IS A CORRELATION AMONG THE              R1P00013
C   ENTITIES IN A UNIT.                                                 R1P00014
C-----------------------------------------------------------------------R1P00015
C-----------------------------------------------------------------------R1P00016
C   CARD 1                                                              R1P00017
C-----------------------------------------------------------------------R1P00018
C      COLUMNS                                                          R1P00019
C       1 - 80         ANY LABEL                                        R1P00020
C-----------------------------------------------------------------------R1P00021
C   CARD 2                                                              R1P00022
C-----------------------------------------------------------------------R1P00023
C      COLUMNS                                                          R1P00024
C       1 - 80         ANY LABEL                                        R1P00025
C-----------------------------------------------------------------------R1P00026
C   CARD 3                                                              R1P00027
C-----------------------------------------------------------------------R1P00028
C      COLUMNS                                                          R1P00029
C       3 - 4          ICORR = NUMBER OF INTRACLASS CORRELATIONS  (LIMIT 20) R1P00030
C       7 - 8          IALP = NUMBER OF SIGNIFICANCE LEVELS (ALPHAS)    R1P00031
C                      (LIMIT 16)                                       R1P00032
C      11 - 12         IES = NUMBER OF EFFECT SIZES (LIMIT 20)          R1P00033
C      13 - 16         LEVEL1 = INITIAL NUMBER OF LEVELS                R1P00034
C      17 - 20         LEVEL2 = TERMINAL NUMBER OF LEVELS               R1P00035
C                                                                       R1P00036
C   $$$  NOTE:   THE PROGRAM PRINTS POWER VALUES FOR ONE FACTOR         R1P00037
C                (ONE-WAY) ANOVA'S THAT HAVE LEVEL1 THROUGH LEVEL2,     R1P00038
C                INCREMENTING BY 1, TREATMENT LEVELS.                   R1P00039
C                                                                       R1P00040
C      23 - 24         IUNIT = THE NUMBER OF GROUPS (UNITS)  (LIMIT 20) R1P00041
C      27 - 28         IENT = THE NUMBER OF DIFFERENT NUMBERS OF ENTITIES R1P00042
C                      PER GROUP  (LIMIT 28)                            R1P00043
C-----------------------------------------------------------------------R1P00044
C   CARD 4                                                              R1P00045
C-----------------------------------------------------------------------R1P00046
C      COLUMNS                                                          R1P00047
C       1 - 4          FIRST INTRACLASS CORRELATION                     R1P00048
C       5 - 8          SECOND INTRACLASS CORRELATION                    R1P00049
C      ETC.                                 ETC.                        R1P00050
C      77 - 80         TWENTIETH INTRACLASS CORRELATION                 R1P00051
C-----------------------------------------------------------------------R1P00052
C   CARD 5                                                              R1P00053
C-----------------------------------------------------------------------R1P00054
C      COLUMNS                                                          R1P00055
C       1 - 5          FIRST LEVEL OF SIGNIFICANCE                      R1P00056
C       6 - 10         SECOND LEVEL OF SIGNIFICANCE                     R1P00057
C      ETC.                                 ETC.                        R1P00058
C      76 - 80         SIXTEENTH LEVEL OF SIGNIFICANCE                  R1P00059
C-----------------------------------------------------------------------R1P00060
```

```
C  CARD 6                                                               R1P00061
C-----------------------------------------------------------------------R1P00062
C    COLUMNS                                                            R1P00063
C     1 - 4      FIRST ENTITY EFFECT SIZE                               R1P00064
C     5 - 8      SECOND ENTITY EFFECT SIZE                              R1P00065
C     ETC.                            ETC.                              R1P00066
C    77 - 80     TWENTIETH ENTITY EFFECT SIZE                           R1P00067
C-----------------------------------------------------------------------R1P00068
C  CARD 7                                                               R1P00069
C-----------------------------------------------------------------------R1P00070
C    COLUMNS                                                            R1P00071
C     1 - 4      FIRST NUMBER OF GROUPS (UNITS)                         R1P00072
C     5 - 8      SECOND NUMBER OF GROUPS (UNITS)                        R1P00073
C     ETC.                            ETC.                              R1P00074
C    77 - 80    TWENTIETH NUMBER OF GROUPS (UNITS)                      R1P00075
C-----------------------------------------------------------------------R1P00076
C-----------------------------------------------------------------------R1P00077
C  CARD 8                                                               R1P00078
C-----------------------------------------------------------------------R1P00079
C    COLUMNS                                                            R1P00080
C     1 - 4      FIRST NUMBER OF ENTITIES PER GROUP (UNITS)             R1P00081
C     6 - 10     SECOND NUMBER OF GROUPS (UNITS)                        R1P00082
C     ETC.                            ETC.                              R1P00083
C    77 - 80     TWENTIETH NUMBER OF GROUPS (UNITS)                     R1P00084
C-----------------------------------------------------------------------R1P00085
C-----------------------------------------------------------------------R1P00086
      DIMENSIONR(20),ES(20),NIT(20),NENT(28),LABEL(40),POW(20),ALPHA(16)R1P00087
      INTEGER ER                                                        R1P00088
      DOUBLE PRECISION RLAM,D1,D2,FA,ZPOW,FPR                           R1P00089
C-----------------------------------------------------------------------R1P00090
C  THE FOLLOWING PROGRAM STATEMENTS READ AND PRINT THE INITIAL PROGRAM  R1P00091
C  PARAMETERS DESCRIBED ABOVE FOR CARD INPUT                            R1P00092
C-----------------------------------------------------------------------R1P00093
    1 READ(5,2,END=26) LABEL                                            R1P00094
    2 FORMAT(20A4)                                                      R1P00095
      PRINT 3,LABEL                                                     R1P00096
    3 FORMAT(1H1,(20A4))                                                R1P00097
      READ 4,ICORR,IALP,IES,LEVEL1,LEVEL2,IUNIT,IENT                    R1P00098
    4 FORMAT(7I4)                                                       R1P00099
      PRINT 5,ICORR,IALP,IES,LEVEL1,LEVEL2,IUNIT,IENT                   R1P00100
    5 FORMAT('0NUMBER OF INTRACLASS CORRELATIONS',I5,//,' NUMBER OF ',  R1P00101
     > 'SIGNIFICANCE LEVELS (ALPHAS)',I5,//,' NUMBER OF EFFECT SIZES',  R1P00102
     >  I5,//' INITIAL NUMBER OF LEVELS',I5,//' TERMINAL NUMBER OF ',   R1P00103
     >  'LEVELS',I5,//' NUMBER OF UNITS',I5,//,' NUMBER OF ENTITIES',I5)R1P00104
      READ 6,(R(I),I=1,ICORR)                                           R1P00105
    6 FORMAT(20F4.0)                                                    R1P00106
      PRINT 7,(R(I),I=1,ICORR)                                          R1P00107
    7 FORMAT('0INTRACLASS CORRELATIONS',/(20F6.2))                      R1P00108
      READ 8,(ALPHA(I),I=1,IALP)                                        R1P00109
    8 FORMAT(16F5.0)                                                    R1P00110
      PRINT 9,(ALPHA(I),I=1,IALP)                                       R1P00111
    9 FORMAT('0ALPHA LEVELS'/(10F8.4))                                  R1P00112
      READ 6,(ES(I),I=1,IES)                                            R1P00113
      PRINT 10,(ES(I),I=1,IES)                                          R1P00114
   10 FORMAT('0EFFECT SIZES',/(20F6.3))                                 R1P00115
      READ 11,(NIT(I),I=1,IUNIT)                                        R1P00116
   11 FORMAT(20I4)                                                      R1P00117
      PRINT 12,(NIT(I),I=1,IUNIT)                                       R1P00118
   12 FORMAT('0NUMBER OF UNITS OF ANALYSIS'/(10I7))                     R1P00119
      READ 11,(NENT(I),I=1,IENT)                                        R1P00120
      PRINT 13,(NENT(I),I=1,IENT)
   13 FORMAT('0ENTITES PER UNIT'/(10I7))
C
C-----------------------------------------------------------------------
C
      ITABLE = 0
C-----------------------------------------------------------------------
C  THE DO 25 LOOPS PRINT A POWER TABLE FOR EACH NEW VALUE OF CORR
C  (THE INTRACLASS CORRELATION), ALP (LEVEL OF SIGNIFICANCE),
C  RES (EFFECT SIZE), AND L (NUMBER OF TREATMENT LEVELS).
C-----------------------------------------------------------------------
      DO 25 I=1,ICORR
      COR = R(I)
      DO 25 J=1,IALP
      ALP = ALPHA(J)
      BLP = 1.0-ALP
      DO 25 K=1,IES
      RES = ES(K)
      DO 25 L=LEVEL1,LEVEL2
      RL = L
C-----------------------------------------------------------------------
C  DF1 IS THE DEGREES OF FREEDOM FOR BETWEEN GROUPS
C  D1 IS THE DOUBLE PRECISIONED DF1
C
      D1 = RL-1.
      DF1 = D1
C-----------------------------------------------------------------------
C-----------------------------------------------------------------------
C  ITABLE IS THE TABLE NUMBER
C
      ITABLE = ITABLE+1
C-----------------------------------------------------------------------
      PRINT 14,ITABLE,COR,ALP,RES,L
   14 FORMAT(1H1,////,T61,'TABLE',I4,/,1H0,T53,'1',/,T36,'STATISTICAL ',
     >  'POWER  WHEN THE INTRACLASS CORRELATION IS',F6.3,', THE',/,1H0,
     >  T38,'LEVEL OF SIGNIFICANCE IS',F7.4,', THE EFFECT SIZE IS',F6.3,
     >  '.',/,1H0,T50,'AND THE NUMBER OF LEVELS IS',I3)
      PRINT 16
      PRINT 15,(NIT(IM),IM=1,IUNIT)
   15 FORMAT(1H0,T59,'NUMBER OF UNITS',/,10X,'ENTITIES',/,10X,'PER UNIT'
     >  ,3X,8(I3,2X),8(I4,1X),4I5)
      PRINT 16
   16 FORMAT(1H0,8X,28('----'))
      DO 25 M=1,IENT
      NSG = NENT(M)
      RNSG = NSG
C-----------------------------------------------------------------------
C  UNITES IS THE EFFECT SIZE FOR A GROUP AND IS BASED ON RNSG
C  (THE NUMBER OF SUBJECTS IN A GROUP), COR (THE INTRACLASS
C  CORRELATION), AND RES (THE ENTITY EFFECT SIZE).
C  THIS IS FORMULA (3.1.10) IN THE TEXT.
C
      UNITES = SQRT(RNSG/(1.0+(RNSG-1.0)*COR))*RES
C-----------------------------------------------------------------------
      DO 19 IM=1,IUNIT
      RNG = NIT(IM)
C-----------------------------------------------------------------------
C  DF2 IS THE NUMBER OF DEGREES OF FREEDOM ASSOCIATED WITH WITHIN
C  TREATMENTS (ERROR)
C  D2 IS THE DOUBLE PRECISIONED DF2
```

```
C                                                                       R1P00181
      D2 = (RNG-1.0)*RL                                                 R1P00182
      DF2 = D2                                                          R1P00183
C-----------------------------------------------------------------------R1P00184
C-----------------------------------------------------------------------R1P00185
C  SUBROUTINE MDFI IS AN IMSL SUBROUTINE THAT RETURNS  AN F VALUE       R1P00186
C  THAT CORRESPONDS TO BLP (1 - ALPHA)                                  R1P00187
C                                                                       R1P00188
      CALL MDFI(BLP,DF1,DF2,REJ1,IER)                                   R1P00189
C-----------------------------------------------------------------------R1P00190
C-----------------------------------------------------------------------R1P00191
C  RLAM IS THE NONCENTRALITY PARAMETER OF THE NONCENTRAL F DISTRIBUTION.R1P00192
C  IT IS FOUND USING FORMULA 10.8.2 (P 462) IN COHEN, J. STATISTICAL    R1P00193
C  POWER ANALYSIS FOR THE BEHAVIORAL SCIENCES.  NEW YORK: ACADEMIC      R1P00194
C  PRESS, 1977.                                                         R1P00195
C                                                                       R1P00196
      RLAM = UNITES*UNITES*RNG*RL                                       R1P00197
C-----------------------------------------------------------------------R1P00198
      FA = REJ1                                                         R1P00199
C-----------------------------------------------------------------------R1P00200
C  SEVZEL IS A SUBROUTINE THAT CALCULATES A Z SCORE ACCORDING TO        R1P00201
C  FORMULA 10.8.1 (P 462) IN THE ABOVE REFERENCED TEXT BY COHEN.        R1P00202
C                                                                       R1P00203
      CALL SEVZEL(RLAM,D1,D2,FA,ZPOW)                                   R1P00204
C-----------------------------------------------------------------------R1P00205
C-----------------------------------------------------------------------R1P00206
C  ZNORM IS A SUBROUTINE THAT CALCULATES THE AREA TO THE LEFT OF THE    R1P00207
C  Z SCORE FOUND IN SEVZEL.  THIS AREA IS THE POWER OF THE F TEST.      R1P00208
C                                                                       R1P00209
      CALL ZNORM(ZPOW,FPR)                                              R1P00210
C-----------------------------------------------------------------------R1P00211
C-----------------------------------------------------------------------R1P00212
C  IF FPR (POWER) IS GREATER THAN .995, THEN ALL OF THE REMAINING       R1P00213
C  POWER VALUES IN A ROW OF POW ARE SET EQUAL TO ONE.                   R1P00214
C                                                                       R1P00215
      IF(FPR.GT..995D0) GO TO 17                                        R1P00216
C-----------------------------------------------------------------------R1P00217
C-----------------------------------------------------------------------R1P00218
C  THE VECTOR POW STORES THE POWER VALUES FOR A GIVEN NUMBER OF         R1P00219
C  ENTITIES (I.E. TO BE OUTPUT IN A ROW OF A GIVEN TABLE)               R1P00220
C                                                                       R1P00221
      POW(IM) = FPR                                                     R1P00222
C-----------------------------------------------------------------------R1P00223
      IF(FPR.LT..1000) POW(IM) = 0.0                                    R1P00224
      GO TO 19                                                          R1P00225
   17 DO 18 IK=IM,IUNIT                                                 R1P00226
   18 POW(IK) = 1.0                                                     R1P00227
      GO TO 20                                                          R1P00228
   19 CONTINUE                                                          R1P00229
C-----------------------------------------------------------------------R1P00230
C  THIS STATEMENT REGULATES THE NUMBER OF ENTITY SIZES PER PAGE (TABLE).R1P00231
C  IT WILL CAUSE A MAXIMUM OF 14 ENTITY SIZES TO BE CONSIDERED PER PAGE.R1P00232
C                                                                       R1P00233
   20 IF(0.EQ.MOD(M,14)) GO TO 24                                       R1P00234
C-----------------------------------------------------------------------R1P00235
C-----------------------------------------------------------------------R1P00236
C  ONE LINE OF A TABLE IS OUTPUT FOR EACH NUMBER OF ENTITIES PER UNIT.  R1P00237
C  UNITS AND GROUPS ARE SYNONYMOUS                                      R1P00238
C                                                                       R1P00239
      PRINT 21,NSG,(POW(ER),ER=1,IUN(T))                                R1P00240
   21 FORMAT(1H0,11X,I4,T22,20F5.2)                                     R1P00241
C-----------------------------------------------------------------------R1P00242
      IF(M-IENT) 25,22,25                                               R1P00243
   22 PRINT 16                                                          R1P00244
      PRINT 23                                                          R1P00245
   23 FORMAT(/////,T11,'1',/,T12,'POWER VALUES LESS THAN .10 WERE SET ',R1P00246
     >  'AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY ',    R1P00247
     >  'INACCURATE.')                                                  R1P00248
      GO TO 25                                                          R1P00249
   24 PRINT 16                                                          R1P00250
      PRINT 23                                                          R1P00251
      PRINT 14,ITABLE,COH,ALP,RES,L                                     R1P00252
      PRINT 16                                                          R1P00253
      PRINT 15,(NIT(IM),IM=1,IUNIT)                                     R1P00254
      PRINT 16                                                          R1P00255
      PRINT 21,NSG,(POW(ER),ER=1,IUNIT)                                 R1P00256
   25 CONTINUE                                                          R1P00257
      GO TO 1                                                           R1P00258
   26 STOP                                                              R1P00259
      END                                                               R1P00260
C-----------------------------------------------------------------------R1P00001
C-----------------------------------------------------------------------R1P00002
C-----------------------------------------------------------------------R1P00003
C   *****  MODIFIED OCTOBER 2, 1979                                     R1P00004
C-----------------------------------------------------------------------R1P00005
C ZNORM CALCULATES THE AREA UNDER THE UNIT NORMAL DISTRIBUTION TO THE   R1P00006
C LEFT OF X.                                                            R1P00007
C-----------------------------------------------------------------------R1P00008
C X IS WHAT IS COMMONLY CALLED A 'Z SCORE'.  THAT IS, A SCORE FROM THE  R1P00009
C NORMAL DISTRIBUTION WITH A MEAN OF 0 AND A VARIANCE OF 1.             R1P00010
C-----------------------------------------------------------------------R1P00011
C THE METHOD USED TO ARRIVE AT THE AREA TO THE LEFT OF X IS DESCRIBED   R1P00012
C IN THE HANDBOOK OF MATHEMATICAL FUNCTIONS ON PAGE 932.                R1P00013
C-----------------------------------------------------------------------R1P00014
C ZNORM REQUIRES THE FOLLOWING PARAMETERS:                              R1P00015
C-----------------------------------------------------------------------R1P00016
C X=Z-VALUE SENT FROM CALLING PROGRAM.                                  R1P00017
C AREA = AREA UNDER THE NORMAL CURVE TO THE LEFT OF Z.                  R1P00018
C-----------------------------------------------------------------------R1P00019
C                                                                       R1P00020
C-----------------------------------------------------------------------R1P00021
      SUBROUTINE ZNORM(X,AREA)                                          R1P00022
      DOUBLE PRECISION AB(5),X,AREA,T,Z,A,TT                            R1P00023
      DATA AB/.319381530D0,-.356563782D0,1.781477937D0,-1.821255978D0,  R1P00024
     >  1.330274429D0/                                                  R1P00025
C **NOTE**  BECAUSE VALUES ARE REPORTED TO TWO DECIMAL PLACES           R1P00026
C           A Z VALUE GREATER THAN 2.58 RETURNS A PROBABILITY           R1P00027
C           OF 1.00 AND A Z VALUE LESS THAN -2.58 RETURNS A             R1P00028
C           PROBABILITY VALUE OF 0.00                                   R1P00029
      IF(DABS(X).GT.2.58D0) GO TO 1                                     R1P00030
      GO TO 2                                                           R1P00031
    1 IF(X.LT.-2.58D0) AREA = 0.D0                                      R1P00032
      IF(X.GT.2.58D0) AREA = 1.D0                                       R1P00033
      RETURN                                                            R1P00034
    2 T = 1.D0/(1.D0+.2316419D0*DABS(X))                                R1P00035
      Z = DEXP(.5D0*(-X)*X)/2.506628273D0                               R1P00036
      A = 0.0                                                           R1P00037
      TT = 1.0                                                          R1P00038
      DO 3 J=1,5                                                        R1P00039
      TT = TT*T                                                         R1P00040
    3 A = A+AU(J)*TT                                                    R1P00041
      AREA = A*2                                                        R1P00042
      IF(X) 5,5,4                                                       R1P00043
    4 AREA = 1.D0-AREA                                                  R1P00044
    5 RETURN                                                            R1P00045
      END                                                               R1P00046
C-----------------------------------------------------------------------R1P00001
C-----------------------------------------------------------------------R1P00002
C SEVZEL CALCULATES THE STANDARD UNIT NORMAL DEVIATE WHICH WHEN SENT    R1P00003
C TO ZNORM IS USED TO FINE THE POWER OF THE F-TEST IN A FIXED EFFECTS   R1P00004
C ANALYSIS OF VARIANCE.                                                 R1P00005
C-----------------------------------------------------------------------R1P00006
C SEVZEL REQUIRES THE FOLLOWING PARAMETERS:                             R1P00007
C-----------------------------------------------------------------------R1P00008
C RLAM---NONCENTRALITY PARAMETER                                        R1P00009
C U---DEGREES OF FREEDOM FOR THE NUMERATOR OF THE F-TEST                R1P00010
C V---DEGREES OF FREEDOM FOR THE DENOMINATOR OF THE F-TEST              R1P00011
C F---F VALUE REQUIRED FOR SIGNIFICANCE WITH U AND V.                   R1P00012
C POW1--- SCORE RETURNED TO MAIN LINE WHICH WHEN SENT TO SUBROUTINE     R1P00013
C ZNORM DETERMINES THE POWER.                                           R1P00014
C-----------------------------------------------------------------------R1P00015
C THE CALCULATIONS ARE BASED ON A METHOD DESCRIBED IN:  LAUBSCHER, N.F. R1P00016
C NORMALIZING THE NONCENTRAL T AND F DISTRIBUTIONS. ANNALS OF           R1P00017
C MATHEMATICAL STATISTICS, 1960, 31, 1105-1112.                         R1P00018
C-----------------------------------------------------------------------R1P00019
C                                                                       R1P00020
C-----------------------------------------------------------------------R1P00021
      SUBROUTINE SEVZEL(RLAM,U,V,F,POW1)                                R1P00022
      DOUBLE PRECISION RLAM,U,V,F,POW1,TEMP1,TEMP2,TEMP3                R1P00023
      TEMP1 = DSQRT(2.D0*(U+RLAM)-(U+2.D0*RLAM)/(U+RLAM))               R1P00024
      TEMP2 = DSQRT(((2.D0*V-1.D0)*U*F)/V)                              R1P00025
      TEMP3 = DSQRT((U*F)/V+(U+2.D0*RLAM)/(U+RLAM))                     R1P00026
      POW1 = (TEMP1-TEMP2)/TEMP3                                        R1P00027
      RETURN                                                            R1P00028
      END                                                               R1P00029
```

```
*
 EXECUTION TIME FOR RIPO ON AN IBM 370 WAS 20 MIN. 5.17 SEC.
```

```
*
  THE FOLLOWING CARD INPUT GENERATED THE PROGRAM OUTPUT ON THE
  FOLLOWING PAGE AND TABLES 4.5.1 - 4.5.36
*
  THE FIRST AND LAST TWO CARDS SERVE TO IDENTIFY COLUMNS AND
  ARE NOT PART OF THE CARD INPUT
*
00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890

  TRIAL RUN FOR FINAL OUTPUT
  WHITE PAPER
   1    3    3    2    5   20   27
 .20
  .01   .05   .10
 .10  .25  .40
   2    3    4    5    6    7    8    9   10   12   15   20   25   30   40   50  100  200 5001000
   1    2    4    6    8   10   12   14   16   18   20   25   30   35   40   45   50   60   70   80
  90  100  200  300  400 5001000

00000000011111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

The tables for RIPO were numbered by the program and then were renumbered on a typewriter.

```
  TRIAL RUN FOR FINAL OUTPUT
 WHITE PAPER

NUMBER OF INTRACLASS CORRELATIONS     1

NUMBER OF SIGNIFICANCE LEVELS (ALPHAS)     3

NUMBER OF EFFECT SIZES     3

INITIAL NUMBER OF LEVELS     2

TERMINAL NUMBER OF LEVELS     5

NUMBER OF UNITS    20

NUMBER OF ENTITIES    27

INTRACLASS CORRELATIONS
 0.20

ALPHA LEVELS
 0.0100  0.0500  0.1000

EFFECT SIZES
0.100 0.250 0.400

NUMBER OF UNITS OF ANALYSIS
       2         3         4         5         6         7         8         9        10        12
      15        20        25        30        40        50       100       200       500      1000

ENTITES PER UNIT
       1         2         4         6         8        10        12        14        16        18
      20        25        30        35        40        45        50        60        70        80
      90       100       200       300       400       500      1000
```

TABLE 4.5.1

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 2

	NUMBER OF UNITS																			
ENTITIES PER UNIT	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.28	0.73	0.97
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.22	0.50	0.94	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.36	0.72	0.99	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.45	0.82	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.21	0.50	0.86	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.23	0.54	0.89	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.18	0.25	0.56	0.90	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.13	0.19	0.26	0.58	0.92	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.13	0.20	0.27	0.60	0.92	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.21	0.28	0.61	0.93	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.21	0.28	0.62	0.94	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.15	0.22	0.30	0.64	0.94	1.00	1.00
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.15	0.23	0.30	0.65	0.95	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.1

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.23	0.31	0.66	0.95	1.00	1.00
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.24	0.32	0.67	0.96	1.00	1.00
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.16	0.24	0.32	0.67	0.96	1.00	1.00
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.16	0.24	0.32	0.68	0.96	1.00	1.00
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.33	0.68	0.96	1.00	1.00
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.33	0.69	0.96	1.00	1.00
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.33	0.69	0.96	1.00	1.00
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.34	0.70	0.96	1.00	1.00
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.34	0.70	0.97	1.00	1.00
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.18	0.26	0.35	0.71	0.97	1.00	1.00
300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.18	0.26	0.35	0.71	0.97	1.00	1.00
400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.18	0.26	0.35	0.71	0.97	1.00	1.00
500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.18	0.26	0.35	0.71	0.97	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.18	0.26	0.35	0.72	0.97	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.2

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.100. AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.34	0.84	0.99
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.27	0.62	0.98	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.45	0.84	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.23	0.55	0.91	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.19	0.26	0.61	0.94	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.21	0.29	0.65	0.96	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.23	0.31	0.68	0.97	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.24	0.32	0.70	0.97	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.25	0.33	0.72	0.98	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.25	0.34	0.73	0.98	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.26	0.35	0.74	0.98	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.18	0.27	0.37	0.76	0.99	1.00	1.00
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.19	0.28	0.38	0.77	0.99	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.2

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.19	0.29	0.39	0.78	0.99	1.00	1.00
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.19	0.29	0.39	0.79	0.99	1.00	1.00
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.20	0.30	0.40	0.79	0.99	1.00	1.00
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.20	0.30	0.40	0.80	0.99	1.00	1.00
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.20	0.30	0.41	0.80	0.99	1.00	1.00
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.20	0.31	0.41	0.81	0.99	1.00	1.00
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.21	0.31	0.42	0.81	0.99	1.00	1.00
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.21	0.31	0.42	0.81	0.99	1.00	1.00
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.21	0.31	0.42	0.82	0.99	1.00	1.00
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.16	0.22	0.32	0.43	0.83	0.99	1.00	1.00
300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.32	0.43	0.83	0.99	1.00	1.00
400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.33	0.44	0.83	0.99	1.00	1.00
500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.33	0.44	0.83	0.99	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.33	0.44	0.83	0.99	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.3

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.100. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.16	0.42	0.91	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.33	0.72	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.16	0.21	0.54	0.91	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.20	0.28	0.65	0.96	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.23	0.32	0.71	0.98	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.17	0.26	0.35	0.75	0.99	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.18	0.27	0.37	0.78	0.99	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.14	0.19	0.29	0.39	0.80	0.99	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.20	0.30	0.41	0.81	0.99	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.20	0.31	0.42	0.83	0.99	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.21	0.32	0.43	0.83	1.00	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.33	0.45	0.85	1.00	1.00	1.00
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.23	0.34	0.46	0.86	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.3

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.18	0.23	0.35	0.47	0.87	1.00	1.00	1.00
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.24	0.36	0.47	0.87	1.00	1.00	1.00
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.24	0.36	0.48	0.88	1.00	1.00	1.00
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.24	0.36	0.49	0.88	1.00	1.00	1.00
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.19	0.25	0.37	0.49	0.89	1.00	1.00	1.00
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.19	0.25	0.37	0.50	0.89	1.00	1.00	1.00
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.25	0.38	0.50	0.89	1.00	1.00	1.00
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.25	0.38	0.50	0.89	1.00	1.00	1.00
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.25	0.38	0.51	0.90	1.00	1.00	1.00
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.26	0.39	0.52	0.90	1.00	1.00	1.00
300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.26	0.40	0.52	0.91	1.00	1.00	1.00
400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.27	0.40	0.52	0.91	1.00	1.00	1.00
500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.27	0.40	0.53	0.91	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.27	0.40	0.53	0.91	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.4

STATISTICAL POWER[I] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.19	0.49	0.96	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.38	0.80	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.18	0.25	0.62	0.96	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.24	0.33	0.73	0.98	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.27	0.38	0.79	0.99	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.15	0.20	0.30	0.41	0.83	1.00	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.16	0.21	0.32	0.44	0.85	1.00	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.22	0.34	0.46	0.87	1.00	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.17	0.23	0.35	0.48	0.88	1.00	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.24	0.36	0.49	0.89	1.00	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.19	0.25	0.37	0.50	0.90	1.00	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.26	0.39	0.52	0.91	1.00	1.00	1.00
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.20	0.27	0.40	0.53	0.92	1.00	1.00	1.00

[I] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.4

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.21	0.27	0.41	0.54	0.92	1.00	1.00	1.00
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.21	0.28	0.42	0.55	0.93	1.00	1.00	1.00
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.21	0.28	0.42	0.56	0.93	1.00	1.00	1.00
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.22	0.29	0.43	0.56	0.93	1.00	1.00	1.00
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.16	0.22	0.29	0.44	0.57	0.94	1.00	1.00	1.00
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.16	0.22	0.29	0.44	0.58	0.94	1.00	1.00	1.00
80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.16	0.23	0.30	0.44	0.58	0.94	1.00	1.00	1.00
90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.16	0.23	0.30	0.45	0.58	0.94	1.00	1.00	1.00
100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.16	0.23	0.30	0.45	0.59	0.94	1.00	1.00	1.00
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.24	0.31	0.46	0.60	0.95	1.00	1.00	1.00
300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.24	0.31	0.46	0.60	0.95	1.00	1.00	1.00
400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.24	0.31	0.47	0.61	0.95	1.00	1.00	1.00
500	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.24	0.31	0.47	0.61	0.95	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.24	0.32	0.47	0.61	0.95	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.5

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.19	0.24	0.35	0.46	0.83	0.99	1.00	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.18	0.26	0.36	0.44	0.60	0.73	0.98	1.00	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.14	0.16	0.21	0.29	0.43	0.56	0.66	0.82	0.91	1.00	1.00	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.12	0.14	0.17	0.20	0.27	0.37	0.52	0.65	0.76	0.89	0.96	1.00	1.00	1.00	1.00
8	0.0	0.0	0.0	0.0	0.10	0.13	0.17	0.20	0.23	0.31	0.41	0.58	0.71	0.81	0.93	0.97	1.00	1.00	1.00	1.00
10	0.0	0.0	0.0	0.0	0.11	0.15	0.18	0.22	0.25	0.33	0.45	0.62	0.75	0.84	0.94	0.98	1.00	1.00	1.00	1.00
12	0.0	0.0	0.0	0.0	0.12	0.15	0.19	0.23	0.27	0.35	0.47	0.64	0.77	0.86	0.95	0.99	1.00	1.00	1.00	1.00
14	0.0	0.0	0.0	0.0	0.13	0.16	0.20	0.24	0.28	0.37	0.49	0.66	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00
16	0.0	0.0	0.0	0.0	0.13	0.17	0.21	0.25	0.29	0.38	0.50	0.68	0.80	0.89	0.97	0.99	1.00	1.00	1.00	1.00
18	0.0	0.0	0.0	0.0	0.13	0.17	0.21	0.26	0.30	0.39	0.52	0.69	0.81	0.89	0.97	0.99	1.00	1.00	1.00	1.00
20	0.0	0.0	0.0	0.10	0.14	0.18	0.22	0.26	0.31	0.40	0.53	0.70	0.82	0.90	0.97	0.99	1.00	1.00	1.00	1.00
25	0.0	0.0	0.0	0.11	0.14	0.18	0.23	0.27	0.32	0.41	0.54	0.72	0.84	0.91	0.98	0.99	1.00	1.00	1.00	1.00
30	0.0	0.0	0.0	0.11	0.15	0.19	0.23	0.28	0.33	0.42	0.56	0.73	0.85	0.92	0.98	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.5

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.11	0.15	0.19	0.24	0.29	0.34	0.43	0.57	0.74	0.86	0.92	0.98	1.00	1.00	1.00	1.00	1.00
40	0.0	0.0	0.0	0.11	0.15	0.20	0.24	0.29	0.34	0.44	0.57	0.75	0.86	0.93	0.98	1.00	1.00	1.00	1.00	1.00
45	0.0	0.0	0.0	0.11	0.15	0.20	0.25	0.30	0.35	0.44	0.58	0.75	0.86	0.93	0.98	1.00	1.00	1.00	1.00	1.00
50	0.0	0.0	0.0	0.11	0.16	0.20	0.25	0.30	0.35	0.45	0.58	0.76	0.87	0.93	0.98	1.00	1.00	1.00	1.00	1.00
60	0.0	0.0	0.0	0.12	0.16	0.20	0.25	0.30	0.35	0.45	0.59	0.76	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00
70	0.0	0.0	0.0	0.12	0.16	0.21	0.26	0.31	0.36	0.46	0.59	0.77	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00
80	0.0	0.0	0.0	0.12	0.16	0.21	0.26	0.31	0.36	0.46	0.60	0.77	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00
90	0.0	0.0	0.0	0.12	0.16	0.21	0.26	0.31	0.36	0.46	0.60	0.77	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00
100	0.0	0.0	0.0	0.12	0.16	0.21	0.26	0.31	0.36	0.47	0.60	0.78	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00
200	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.32	0.37	0.48	0.61	0.79	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00
300	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.32	0.38	0.48	0.62	0.79	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00
400	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.32	0.38	0.48	0.62	0.79	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00
500	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.32	0.38	0.48	0.62	0.79	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.33	0.38	0.48	0.62	0.79	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.6

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.17	0.23	0.30	0.44	0.56	0.92	1.00	1.00	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.15	0.22	0.33	0.44	0.55	0.73	0.85	1.00	1.00	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.17	0.20	0.27	0.37	0.53	0.68	0.78	0.91	0.97	1.00	1.00	1.00	1.00
6	0.0	0.0	0.0	0.0	0.11	0.14	0.18	0.22	0.25	0.34	0.46	0.64	0.76	0.87	0.96	0.99	1.00	1.00	1.00	1.00
8	0.0	0.0	0.0	0.0	0.12	0.16	0.20	0.25	0.29	0.38	0.52	0.70	0.83	0.91	0.98	1.00	1.00	1.00	1.00	1.00
10	0.0	0.0	0.0	0.0	0.14	0.18	0.22	0.27	0.32	0.42	0.56	0.74	0.86	0.93	0.99	1.00	1.00	1.00	1.00	1.00
12	0.0	0.0	0.0	0.11	0.15	0.19	0.24	0.29	0.34	0.44	0.59	0.77	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00
14	0.0	0.0	0.0	0.11	0.15	0.20	0.25	0.30	0.36	0.46	0.61	0.79	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00
16	0.0	0.0	0.0	0.11	0.16	0.21	0.26	0.31	0.37	0.48	0.62	0.80	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00
18	0.0	0.0	0.0	0.12	0.16	0.21	0.27	0.32	0.38	0.49	0.64	0.81	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00
20	0.0	0.0	0.0	0.12	0.17	0.22	0.27	0.33	0.39	0.50	0.65	0.82	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.0	0.0	0.13	0.17	0.23	0.29	0.35	0.41	0.52	0.67	0.84	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.0	0.0	0.13	0.18	0.24	0.30	0.36	0.42	0.53	0.68	0.86	0.94	0.97	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.6

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.13	0.18	0.24	0.30	0.36	0.43	0.54	0.69	0.86	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.0	0.0	0.13	0.19	0.25	0.31	0.37	0.43	0.55	0.70	0.86	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.0	0.0	0.14	0.19	0.25	0.31	0.37	0.44	0.55	0.70	0.87	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.0	0.0	0.14	0.19	0.25	0.31	0.38	0.44	0.56	0.71	0.87	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.0	0.0	0.14	0.20	0.26	0.32	0.38	0.45	0.57	0.72	0.87	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.0	0.0	0.14	0.20	0.26	0.32	0.39	0.45	0.57	0.72	0.88	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.0	0.0	0.14	0.20	0.26	0.33	0.39	0.46	0.58	0.72	0.88	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.0	0.0	0.14	0.20	0.26	0.33	0.39	0.46	0.58	0.73	0.88	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.0	0.0	0.14	0.20	0.26	0.33	0.40	0.46	0.58	0.73	0.88	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.0	0.0	0.15	0.21	0.27	0.34	0.41	0.47	0.59	0.74	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.0	0.0	0.15	0.21	0.27	0.34	0.41	0.47	0.60	0.74	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.0	0.0	0.15	0.21	0.27	0.34	0.41	0.48	0.60	0.75	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.0	0.0	0.15	0.21	0.28	0.34	0.41	0.48	0.60	0.75	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.0	0.10	0.15	0.21	0.28	0.35	0.41	0.48	0.60	0.75	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.7

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.13	0.20	0.28	0.36	0.53	0.67	0.97	1.00	1.00	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.14	0.19	0.26	0.40	0.54	0.65	0.82	0.92	1.00	1.00	1.00	1.00
4	0.0	0.0	0.0	0.0	0.10	0.13	0.17	0.21	0.24	0.33	0.45	0.64	0.78	0.87	0.96	0.99	1.00	1.00	1.00	1.00
6	0.0	0.0	0.0	0.0	0.13	0.17	0.22	0.27	0.31	0.41	0.56	0.75	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00
8	0.0	0.0	0.0	0.11	0.15	0.20	0.25	0.31	0.36	0.47	0.62	0.80	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00
10	0.0	0.0	0.0	0.12	0.17	0.22	0.28	0.34	0.40	0.51	0.66	0.84	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.0	0.0	0.13	0.18	0.24	0.30	0.36	0.42	0.54	0.69	0.86	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.0	0.0	0.13	0.19	0.25	0.31	0.38	0.44	0.56	0.71	0.88	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.0	0.0	0.14	0.20	0.26	0.32	0.39	0.45	0.58	0.73	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.0	0.0	0.14	0.20	0.27	0.33	0.40	0.47	0.59	0.74	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.0	0.0	0.15	0.21	0.27	0.34	0.41	0.48	0.60	0.75	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.0	0.10	0.15	0.22	0.28	0.36	0.43	0.50	0.62	0.77	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.0	0.10	0.16	0.22	0.29	0.37	0.44	0.51	0.64	0.78	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.7

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.11	0.16	0.23	0.30	0.38	0.45	0.52	0.65	0.79	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.0	0.11	0.17	0.23	0.31	0.38	0.46	0.53	0.66	0.80	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.0	0.11	0.17	0.24	0.31	0.39	0.46	0.53	0.66	0.81	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.0	0.11	0.17	0.24	0.31	0.39	0.47	0.54	0.67	0.81	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.0	0.11	0.17	0.24	0.32	0.40	0.47	0.55	0.67	0.82	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.0	0.11	0.17	0.25	0.32	0.40	0.48	0.55	0.68	0.82	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.0	0.11	0.18	0.25	0.33	0.40	0.48	0.56	0.68	0.82	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.0	0.12	0.18	0.25	0.33	0.41	0.48	0.56	0.69	0.83	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.0	0.12	0.18	0.25	0.33	0.41	0.49	0.56	0.69	0.83	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.0	0.12	0.18	0.26	0.34	0.42	0.50	0.57	0.70	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.0	0.12	0.18	0.26	0.34	0.42	0.50	0.58	0.70	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.0	0.12	0.19	0.26	0.34	0.42	0.50	0.58	0.71	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.0	0.12	0.19	0.26	0.34	0.43	0.51	0.58	0.71	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.0	0.12	0.19	0.26	0.35	0.43	0.51	0.58	0.71	0.85	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.8

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.15	0.24	0.33	0.43	0.61	0.75	0.99	1.00	1.00	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.16	0.22	0.31	0.47	0.62	0.74	0.89	0.96	1.00	1.00	1.00	1.00
4	0.0	0.0	0.0	0.0	0.12	0.16	0.20	0.25	0.29	0.39	0.53	0.72	0.85	0.93	0.99	1.00	1.00	1.00	1.00	1.00
6	0.0	0.0	0.0	0.11	0.16	0.21	0.26	0.32	0.38	0.49	0.64	0.83	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00
8	0.0	0.0	0.0	0.13	0.18	0.24	0.30	0.37	0.43	0.56	0.71	0.87	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
10	0.0	0.0	0.0	0.14	0.20	0.26	0.33	0.40	0.47	0.60	0.75	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.0	0.0	0.15	0.21	0.28	0.35	0.43	0.50	0.63	0.78	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.0	0.10	0.16	0.23	0.30	0.37	0.45	0.52	0.65	0.80	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.0	0.11	0.17	0.23	0.31	0.39	0.46	0.54	0.67	0.81	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.0	0.11	0.17	0.24	0.32	0.40	0.48	0.55	0.68	0.82	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.0	0.11	0.18	0.25	0.33	0.41	0.49	0.56	0.69	0.83	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.0	0.12	0.18	0.26	0.34	0.43	0.51	0.58	0.71	0.85	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.0	0.12	0.19	0.27	0.35	0.44	0.52	0.60	0.73	0.86	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.8

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.13	0.20	0.28	0.36	0.45	0.53	0.61	0.74	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.0	0.13	0.20	0.28	0.37	0.45	0.54	0.61	0.74	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.0	0.13	0.20	0.28	0.37	0.46	0.54	0.62	0.75	0.88	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.0	0.13	0.20	0.29	0.38	0.47	0.55	0.63	0.75	0.88	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.0	0.13	0.21	0.29	0.38	0.47	0.56	0.63	0.76	0.89	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.0	0.13	0.21	0.30	0.39	0.48	0.56	0.64	0.77	0.89	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.0	0.14	0.21	0.30	0.39	0.48	0.57	0.64	0.77	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.0	0.14	0.21	0.30	0.39	0.48	0.57	0.65	0.77	0.89	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.0	0.14	0.22	0.30	0.40	0.49	0.57	0.65	0.78	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.0	0.14	0.22	0.31	0.41	0.50	0.58	0.66	0.79	0.90	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.0	0.14	0.22	0.31	0.41	0.50	0.59	0.67	0.79	0.91	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.0	0.14	0.22	0.32	0.41	0.50	0.59	0.67	0.79	0.91	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.0	0.14	0.23	0.32	0.41	0.51	0.59	0.67	0.79	0.91	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.0	0.14	0.23	0.32	0.41	0.51	0.59	0.67	0.80	0.91	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.9

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.14	0.17	0.22	0.30	0.44	0.57	0.67	0.83	0.92	1.00	1.00	1.00	1.00
2	0.0	0.0	0.0	0.10	0.14	0.18	0.23	0.27	0.32	0.41	0.54	0.71	0.83	0.91	0.98	0.99	1.00	1.00	1.00	1.00
4	0.0	0.0	0.11	0.17	0.23	0.30	0.37	0.43	0.50	0.62	0.76	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00
6	0.0	0.0	0.14	0.21	0.29	0.37	0.45	0.53	0.60	0.72	0.84	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.0	0.0	0.15	0.23	0.32	0.42	0.50	0.58	0.65	0.77	0.89	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.0	0.0	0.17	0.25	0.35	0.45	0.54	0.62	0.69	0.81	0.91	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.10	0.18	0.27	0.37	0.47	0.56	0.65	0.72	0.83	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.11	0.18	0.28	0.39	0.49	0.58	0.67	0.74	0.84	0.93	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.11	0.19	0.29	0.40	0.50	0.60	0.68	0.75	0.86	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.11	0.19	0.30	0.41	0.52	0.61	0.69	0.76	0.86	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.11	0.20	0.30	0.42	0.53	0.62	0.70	0.77	0.87	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.12	0.21	0.32	0.43	0.54	0.64	0.72	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.12	0.21	0.33	0.44	0.56	0.65	0.73	0.80	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.9

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.12	0.21	0.33	0.45	0.56	0.66	0.74	0.81	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.12	0.22	0.34	0.46	0.57	0.67	0.75	0.81	0.90	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.12	0.22	0.34	0.46	0.58	0.67	0.76	0.82	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.12	0.22	0.34	0.47	0.58	0.68	0.76	0.82	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.13	0.23	0.35	0.47	0.59	0.69	0.77	0.83	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.13	0.23	0.35	0.48	0.59	0.69	0.77	0.83	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.13	0.23	0.35	0.48	0.60	0.69	0.77	0.84	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.13	0.23	0.36	0.48	0.60	0.70	0.78	0.84	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.13	0.23	0.36	0.49	0.60	0.70	0.78	0.84	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.13	0.24	0.37	0.50	0.61	0.71	0.79	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.13	0.24	0.37	0.50	0.62	0.71	0.79	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.13	0.24	0.37	0.50	0.62	0.71	0.79	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.13	0.24	0.37	0.50	0.62	0.72	0.79	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.13	0.24	0.37	0.50	0.62	0.72	0.80	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.10

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.17	0.21	0.27	0.38	0.55	0.69	0.80	0.92	0.97	1.00	1.00	1.00	1.00
2	0.0	0.0	0.0	0.12	0.17	0.23	0.28	0.34	0.40	0.51	0.66	0.83	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00
4	0.0	0.0	0.14	0.21	0.29	0.38	0.47	0.55	0.62	0.75	0.87	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.0	0.0	0.17	0.26	0.37	0.47	0.57	0.65	0.73	0.84	0.93	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.0	0.11	0.19	0.30	0.42	0.53	0.63	0.72	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.0	0.11	0.21	0.33	0.45	0.57	0.67	0.75	0.82	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.12	0.22	0.35	0.48	0.60	0.70	0.78	0.84	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.13	0.24	0.37	0.50	0.62	0.72	0.80	0.86	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.13	0.24	0.38	0.51	0.64	0.73	0.81	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.13	0.25	0.39	0.53	0.65	0.75	0.82	0.88	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.14	0.26	0.40	0.54	0.66	0.76	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.14	0.27	0.41	0.56	0.68	0.78	0.85	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.14	0.28	0.43	0.57	0.69	0.79	0.86	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.10

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.15	0.28	0.43	0.58	0.70	0.80	0.87	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.15	0.29	0.44	0.59	0.71	0.80	0.87	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.15	0.29	0.45	0.59	0.71	0.81	0.88	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.15	0.29	0.45	0.60	0.72	0.81	0.88	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.15	0.30	0.46	0.60	0.73	0.82	0.88	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.16	0.30	0.46	0.61	0.73	0.82	0.89	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.16	0.30	0.47	0.61	0.74	0.83	0.89	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.16	0.30	0.47	0.62	0.74	0.83	0.89	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.16	0.31	0.47	0.62	0.74	0.83	0.89	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.16	0.31	0.48	0.63	0.75	0.84	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.16	0.32	0.48	0.63	0.75	0.84	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.16	0.32	0.49	0.64	0.76	0.84	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.17	0.32	0.49	0.64	0.76	0.84	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.17	0.32	0.49	0.64	0.76	0.85	0.91	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.11

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.11	0.14	0.17	0.21	0.25	0.34	0.46	0.65	0.79	0.88	0.97	0.99	1.00	1.00	1.00	1.00
2	0.0	0.0	0.0	0.15	0.21	0.28	0.35	0.42	0.49	0.62	0.77	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
4	0.0	0.0	0.17	0.26	0.37	0.47	0.57	0.66	0.73	0.85	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.0	0.11	0.21	0.34	0.46	0.58	0.68	0.77	0.83	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.0	0.13	0.25	0.38	0.52	0.64	0.74	0.82	0.88	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.0	0.14	0.27	0.42	0.56	0.68	0.78	0.85	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.15	0.29	0.44	0.59	0.71	0.81	0.88	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.16	0.30	0.46	0.61	0.73	0.83	0.89	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.16	0.31	0.48	0.63	0.75	0.84	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.17	0.32	0.49	0.64	0.76	0.86	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.17	0.33	0.50	0.66	0.77	0.86	0.92	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.18	0.34	0.52	0.67	0.79	0.87	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.18	0.35	0.53	0.69	0.80	0.88	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.11

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0100. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.19	0.36	0.54	0.70	0.81	0.89	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.19	0.37	0.55	0.71	0.82	0.89	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.19	0.37	0.56	0.71	0.82	0.90	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.20	0.38	0.56	0.72	0.83	0.90	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.20	0.38	0.57	0.72	0.83	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.20	0.39	0.58	0.73	0.84	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.20	0.39	0.58	0.73	0.84	0.91	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.20	0.39	0.58	0.74	0.84	0.91	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.20	0.40	0.59	0.74	0.85	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.21	0.40	0.60	0.75	0.86	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.21	0.41	0.60	0.75	0.86	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.21	0.41	0.60	0.76	0.86	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.21	0.41	0.60	0.76	0.86	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.21	0.41	0.61	0.76	0.86	0.93	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.12

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.12	0.16	0.21	0.25	0.30	0.40	0.54	0.74	0.86	0.93	0.99	1.00	1.00	1.00	1.00	1.00
2	0.0	0.0	0.12	0.18	0.26	0.34	0.42	0.50	0.58	0.71	0.84	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.0	0.11	0.20	0.32	0.44	0.56	0.66	0.75	0.82	0.91	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.0	0.14	0.26	0.41	0.55	0.67	0.77	0.85	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.0	0.16	0.30	0.47	0.61	0.74	0.83	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.0	0.17	0.33	0.50	0.66	0.78	0.86	0.92	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.0	0.18	0.35	0.53	0.69	0.80	0.88	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.0	0.19	0.37	0.56	0.71	0.82	0.90	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.0	0.20	0.39	0.57	0.73	0.84	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.0	0.21	0.40	0.59	0.74	0.85	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.0	0.21	0.41	0.60	0.75	0.86	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.0	0.22	0.42	0.62	0.77	0.87	0.93	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.0	0.23	0.44	0.63	0.78	0.88	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.12

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0100, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.23	0.45	0.64	0.79	0.89	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.0	0.24	0.45	0.65	0.80	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.0	0.24	0.46	0.66	0.81	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.0	0.24	0.46	0.66	0.81	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.0	0.25	0.47	0.67	0.82	0.91	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.0	0.25	0.47	0.68	0.82	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.0	0.25	0.48	0.68	0.82	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.0	0.25	0.48	0.68	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.0	0.26	0.48	0.69	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.0	0.26	0.50	0.70	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.0	0.27	0.50	0.70	0.84	0.92	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.0	0.27	0.50	0.70	0.84	0.92	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.0	0.27	0.50	0.71	0.84	0.92	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.0	0.27	0.50	0.71	0.85	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.13

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.16	0.29	0.53	0.89	0.99
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.14	0.16	0.21	0.25	0.45	0.74	0.98	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.13	0.16	0.19	0.23	0.29	0.3[illegible]	0.62	0.89	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.15	0.18	0.22	0.26	0.34	0.41	0.70	0.94	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.16	0.20	0.24	0.29	0.37	0.45	0.74	0.96	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.17	0.21	0.26	0.31	0.39	0.47	0.77	0.97	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.12	0.14	0.17	0.22	0.27	0.32	0.41	0.49	0.79	0.97	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.18	0.23	0.28	0.33	0.42	0.51	0.80	0.98	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.13	0.15	0.18	0.23	0.29	0.34	0.43	0.52	0.81	0.98	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.13	0.15	0.19	0.24	0.29	0.34	0.44	0.53	0.82	0.98	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.13	0.16	0.19	0.24	0.30	0.35	0.45	0.54	0.83	0.98	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.19	0.25	0.31	0.36	0.46	0.55	0.84	0.99	1.00	1.00
30	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.20	0.25	0.31	0.37	0.47	0.56	0.85	0.99	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.13

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.20	0.26	0.32	0.37	0.47	0.57	0.85	0.99	1.00	1.00
40	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.17	0.20	0.26	0.32	0.38	0.48	0.57	0.86	0.99	1.00	1.00
45	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.17	0.20	0.26	0.32	0.38	0.48	0.58	0.86	0.99	1.00	1.00
50	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.17	0.21	0.27	0.32	0.38	0.49	0.58	0.86	0.99	1.00	1.00
60	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.13	0.15	0.17	0.21	0.27	0.33	0.39	0.49	0.58	0.87	0.99	1.00	1.00
70	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.27	0.33	0.39	0.49	0.59	0.87	0.99	1.00	1.00
80	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.27	0.33	0.39	0.50	0.59	0.87	0.99	1.00	1.00
90	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.27	0.33	0.39	0.50	0.59	0.88	0.99	1.00	1.00
100	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.27	0.34	0.39	0.50	0.60	0.88	0.99	1.00	1.00
200	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.15	0.18	0.22	0.28	0.34	0.40	0.51	0.60	0.88	0.99	1.00	1.00
300	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.28	0.34	0.40	0.51	0.61	0.89	0.99	1.00	1.00
400	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.28	0.34	0.40	0.51	0.61	0.89	0.99	1.00	1.00
500	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.28	0.34	0.40	0.51	0.61	0.89	0.99	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.28	0.35	0.41	0.52	0.61	0.89	0.99	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.14

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.12	0.15	0.18	0.33	0.59	0.95	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.13	0.15	0.17	0.22	0.27	0.51	0.82	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.14	0.17	0.21	0.25	0.32	0.39	0.69	0.94	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.11	0.13	0.16	0.20	0.24	0.29	0.38	0.46	0.77	0.97	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.17	0.22	0.27	0.32	0.41	0.50	0.82	0.99	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.18	0.23	0.28	0.34	0.44	0.53	0.84	0.99	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.13	0.15	0.19	0.24	0.30	0.35	0.46	0.56	0.86	0.99	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.16	0.19	0.25	0.31	0.36	0.47	0.57	0.87	0.99	1.00	1.00
16	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.20	0.26	0.32	0.37	0.48	0.58	0.88	1.00	1.00	1.00
18	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.20	0.26	0.32	0.38	0.49	0.59	0.89	1.00	1.00	1.00
20	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.17	0.20	0.26	0.33	0.39	0.50	0.60	0.90	1.00	1.00	1.00
25	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.17	0.21	0.27	0.34	0.40	0.52	0.62	0.91	1.00	1.00	1.00
30	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.28	0.34	0.41	0.53	0.63	0.91	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.14

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.15	0.18	0.22	0.28	0.35	0.41	0.53	0.64	0.92	1.00	1.00	1.00
40	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.15	0.18	0.22	0.29	0.35	0.42	0.54	0.64	0.92	1.00	1.00	1.00
45	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.29	0.36	0.42	0.54	0.65	0.92	1.00	1.00	1.00
50	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.22	0.29	0.36	0.43	0.55	0.65	0.93	1.00	1.00	1.00
60	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.16	0.18	0.22	0.29	0.36	0.43	0.55	0.66	0.93	1.00	1.00	1.00
70	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.18	0.23	0.30	0.37	0.43	0.56	0.66	0.93	1.00	1.00	1.00
80	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.19	0.23	0.30	0.37	0.44	0.56	0.66	0.93	1.00	1.00	1.00
90	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.19	0.23	0.30	0.37	0.44	0.56	0.67	0.93	1.00	1.00	1.00
100	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.23	0.30	0.37	0.44	0.56	0.67	0.94	1.00	1.00	1.00
200	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.23	0.31	0.38	0.45	0.57	0.68	0.94	1.00	1.00	1.00
300	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.23	0.31	0.38	0.45	0.58	0.68	0.94	1.00	1.00	1.00
400	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.24	0.31	0.38	0.45	0.58	0.68	0.94	1.00	1.00	1.00
500	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.24	0.31	0.38	0.45	0.58	0.68	0.94	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.16	0.19	0.24	0.31	0.38	0.45	0.58	0.68	0.94	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.15

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.13	0.16	0.19	0.36	0.66	0.98	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.13	0.16	0.19	0.25	0.30	0.57	0.88	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.19	0.23	0.27	0.36	0.44	0.76	0.97	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.17	0.22	0.27	0.32	0.42	0.52	0.84	0.99	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.18	0.24	0.30	0.35	0.46	0.57	0.88	1.00	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.16	0.19	0.25	0.32	0.38	0.49	0.60	0.90	1.00	1.00	1.00
12	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.16	0.20	0.27	0.33	0.40	0.52	0.62	0.92	1.00	1.00	1.00
14	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.17	0.21	0.28	0.34	0.41	0.53	0.64	0.93	1.00	1.00	1.00
16	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.17	0.21	0.28	0.35	0.42	0.54	0.65	0.93	1.00	1.00	1.00
18	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.15	0.18	0.22	0.29	0.36	0.43	0.55	0.66	0.94	1.00	1.00	1.00
20	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.15	0.18	0.22	0.29	0.37	0.44	0.56	0.67	0.94	1.00	1.00	1.00
25	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.16	0.19	0.23	0.30	0.38	0.45	0.58	0.69	0.95	1.00	1.00	1.00
30	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.23	0.31	0.39	0.46	0.59	0.70	0.95	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.15

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.24	0.32	0.39	0.47	0.60	0.71	0.96	1.00	1.00	1.00
40	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.16	0.19	0.24	0.32	0.40	0.47	0.60	0.71	0.96	1.00	1.00	1.00
45	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.20	0.24	0.32	0.40	0.47	0.61	0.72	0.96	1.00	1.00	1.00
50	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.20	0.24	0.32	0.40	0.48	0.61	0.72	0.96	1.00	1.00	1.00
60	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.20	0.25	0.33	0.41	0.48	0.62	0.73	0.96	1.00	1.00	1.00
70	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.20	0.25	0.33	0.41	0.49	0.62	0.73	0.97	1.00	1.00	1.00
80	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.15	0.17	0.20	0.25	0.33	0.41	0.49	0.63	0.73	0.97	1.00	1.00	1.00
90	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.17	0.20	0.25	0.33	0.42	0.49	0.63	0.74	0.97	1.00	1.00	1.00
100	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.17	0.20	0.25	0.34	0.42	0.49	0.63	0.74	0.97	1.00	1.00	1.00
200	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.17	0.21	0.26	0.34	0.42	0.50	0.64	0.75	0.97	1.00	1.00	1.00
300	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.18	0.21	0.26	0.34	0.43	0.51	0.64	0.75	0.97	1.00	1.00	1.00
400	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.16	0.18	0.21	0.26	0.35	0.43	0.51	0.64	0.75	0.97	1.00	1.00	1.00
500	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.16	0.18	0.21	0.26	0.35	0.43	0.51	0.65	0.75	0.97	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.16	0.18	0.21	0.26	0.35	0.43	0.51	0.65	0.76	0.97	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.16

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.12	0.13	0.17	0.21	0.40	0.72	0.99	1.00
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.14	0.17	0.20	0.27	0.33	0.63	0.92	1.00	1.00
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.10	0.11	0.13	0.15	0.20	0.25	0.30	0.40	0.49	0.82	0.99	1.00	1.00
6	0.0	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.18	0.24	0.30	0.35	0.47	0.57	0.89	1.00	1.00	1.00
8	0.0	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.16	0.20	0.26	0.33	0.39	0.51	0.62	0.92	1.00	1.00	1.00
10	0.0	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.14	0.17	0.21	0.28	0.35	0.42	0.55	0.66	0.94	1.00	1.00	1.00
12	0.0	0.0	0.0	0.0	0.10	0.11	0.12	0.14	0.15	0.18	0.22	0.29	0.37	0.44	0.57	0.68	0.95	1.00	1.00	1.00
14	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.15	0.18	0.23	0.30	0.38	0.45	0.59	0.70	0.96	1.00	1.00	1.00
16	0.0	0.0	0.0	0.0	0.10	0.12	0.13	0.14	0.16	0.19	0.23	0.31	0.39	0.46	0.60	0.71	0.96	1.00	1.00	1.00
18	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.24	0.32	0.40	0.47	0.61	0.72	0.97	1.00	1.00	1.00
20	0.0	0.0	0.0	0.0	0.11	0.12	0.13	0.15	0.16	0.19	0.24	0.32	0.40	0.48	0.62	0.73	0.97	1.00	1.00	1.00
25	0.0	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.20	0.25	0.33	0.42	0.50	0.64	0.75	0.97	1.00	1.00	1.00
30	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.17	0.20	0.26	0.34	0.43	0.51	0.65	0.76	0.98	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.16

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0500. THE EFFECT SIZE IS 0.100. AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.17	0.21	0.26	0.35	0.43	0.51	0.66	0.77	0.98	1.00	1.00	1.00
40	0.0	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.18	0.21	0.26	0.35	0.44	0.52	0.66	0.77	0.98	1.00	1.00	1.00
45	0.0	0.0	0.0	0.10	0.11	0.13	0.14	0.16	0.18	0.21	0.27	0.36	0.44	0.53	0.67	0.78	0.98	1.00	1.00	1.00
50	0.0	0.0	0.0	0.10	0.11	0.13	0.15	0.16	0.18	0.21	0.27	0.36	0.45	0.53	0.67	0.78	0.98	1.00	1.00	1.00
60	0.0	0.0	0.0	0.10	0.12	0.13	0.15	0.16	0.18	0.22	0.27	0.36	0.45	0.53	0.68	0.79	0.98	1.00	1.00	1.00
70	0.0	0.0	0.0	0.10	0.12	0.13	0.15	0.17	0.18	0.22	0.27	0.37	0.46	0.54	0.68	0.79	0.98	1.00	1.00	1.00
80	0.0	0.0	0.0	0.10	0.12	0.13	0.15	0.17	0.18	0.22	0.27	0.37	0.46	0.54	0.69	0.79	0.98	1.00	1.00	1.00
90	0.0	0.0	0.0	0.10	0.12	0.13	0.15	0.17	0.18	0.22	0.28	0.37	0.46	0.54	0.69	0.80	0.99	1.00	1.00	1.00
100	0.0	0.0	0.0	0.10	0.12	0.13	0.15	0.17	0.19	0.22	0.28	0.37	0.46	0.55	0.69	0.80	0.99	1.00	1.00	1.00
200	0.0	0.0	0.0	0.10	0.12	0.14	0.15	0.17	0.19	0.23	0.28	0.38	0.47	0.56	0.70	0.81	0.99	1.00	1.00	1.00
300	0.0	0.0	0.0	0.10	0.12	0.14	0.15	0.17	0.19	0.23	0.28	0.38	0.47	0.56	0.70	0.81	0.99	1.00	1.00	1.00
400	0.0	0.0	0.0	0.10	0.12	0.14	0.15	0.17	0.19	0.23	0.28	0.38	0.47	0.56	0.71	0.81	0.99	1.00	1.00	1.00
500	0.0	0.0	0.0	0.10	0.12	0.14	0.15	0.17	0.19	0.23	0.29	0.38	0.48	0.56	0.71	0.81	0.99	1.00	1.00	1.00
1000	0.0	0.0	0.0	0.11	0.12	0.14	0.15	0.17	0.19	0.23	0.29	0.38	0.48	0.56	0.71	0.81	0.99	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.17

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.10	0.0	0.0	0.11	0.12	0.13	0.15	0.17	0.18	0.22	0.26	0.34	0.42	0.49	0.61	0.71	0.94	1.00	1.00	1.00
2	0.11	0.10	0.12	0.15	0.17	0.20	0.23	0.25	0.28	0.33	0.41	0.52	0.62	0.70	0.82	0.90	1.00	1.00	1.00	1.00
4	0.12	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.39	0.47	0.56	0.69	0.79	0.86	0.94	0.98	1.00	1.00	1.00	1.00
6	0.12	0.14	0.18	0.23	0.28	0.32	0.37	0.41	0.46	0.54	0.64	0.77	0.86	0.91	0.97	0.99	1.00	1.00	1.00	1.00
8	0.12	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.58	0.69	0.81	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00
10	0.13	0.15	0.21	0.26	0.32	0.37	0.43	0.48	0.52	0.61	0.71	0.84	0.91	0.95	0.99	1.00	1.00	1.00	1.00	1.00
12	0.13	0.16	0.21	0.27	0.33	0.39	0.44	0.50	0.54	0.63	0.74	0.85	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00
14	0.13	0.16	0.22	0.28	0.34	0.40	0.46	0.51	0.56	0.65	0.75	0.87	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00
16	0.13	0.17	0.23	0.29	0.35	0.41	0.47	0.52	0.57	0.66	0.76	0.88	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00
18	0.13	0.17	0.23	0.29	0.36	0.42	0.48	0.53	0.58	0.67	0.77	0.88	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00
20	0.13	0.17	0.23	0.30	0.36	0.43	0.48	0.54	0.59	0.68	0.78	0.89	0.95	0.97	1.00	1.00	1.00	1.00	1.00	1.00
25	0.13	0.17	0.24	0.31	0.37	0.44	0.50	0.55	0.60	0.69	0.79	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
30	0.13	0.18	0.24	0.31	0.38	0.45	0.51	0.56	0.61	0.70	0.80	0.90	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.17

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.14	0.18	0.25	0.32	0.39	0.45	0.51	0.57	0.62	0.71	0.81	0.91	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
40	0.14	0.18	0.25	0.32	0.39	0.46	0.52	0.57	0.63	0.71	0.81	0.91	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
45	0.14	0.18	0.25	0.32	0.39	0.46	0.52	0.58	0.63	0.72	0.82	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
50	0.14	0.18	0.25	0.33	0.40	0.46	0.53	0.58	0.63	0.72	0.82	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
60	0.14	0.18	0.26	0.33	0.40	0.47	0.53	0.59	0.64	0.73	0.82	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
70	0.14	0.18	0.26	0.33	0.40	0.47	0.53	0.59	0.64	0.73	0.83	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
80	0.14	0.19	0.26	0.33	0.41	0.47	0.54	0.59	0.65	0.73	0.83	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
90	0.14	0.19	0.26	0.34	0.41	0.48	0.54	0.60	0.65	0.74	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
100	0.14	0.19	0.26	0.34	0.41	0.48	0.54	0.60	0.65	0.74	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
200	0.14	0.19	0.26	0.34	0.42	0.49	0.55	0.61	0.66	0.75	0.84	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
300	0.14	0.19	0.27	0.34	0.42	0.49	0.55	0.61	0.66	0.75	0.84	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
400	0.14	0.19	0.27	0.34	0.42	0.49	0.55	0.61	0.66	0.75	0.84	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
500	0.14	0.19	0.27	0.35	0.42	0.49	0.55	0.61	0.66	0.75	0.84	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.14	0.19	0.27	0.35	0.42	0.49	0.56	0.61	0.66	0.75	0.85	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.18

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.11	0.13	0.14	0.16	0.18	0.20	0.23	0.29	0.38	0.47	0.55	0.68	0.79	0.98	1.00	1.00	1.00
2	0.0	0.10	0.13	0.15	0.18	0.21	0.24	0.28	0.31	0.37	0.46	0.59	0.69	0.78	0.89	0.95	1.00	1.00	1.00	1.00
4	0.10	0.13	0.17	0.21	0.26	0.30	0.35	0.40	0.44	0.52	0.63	0.77	0.86	0.92	0.98	0.99	1.00	1.00	1.00	1.00
6	0.11	0.14	0.19	0.25	0.30	0.36	0.41	0.46	0.51	0.60	0.72	0.85	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00
8	0.11	0.15	0.21	0.27	0.33	0.39	0.45	0.51	0.56	0.65	0.76	0.88	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
10	0.12	0.16	0.22	0.29	0.35	0.42	0.48	0.54	0.59	0.68	0.79	0.90	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
12	0.12	0.16	0.23	0.30	0.37	0.44	0.50	0.56	0.61	0.71	0.81	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
14	0.12	0.17	0.24	0.31	0.38	0.45	0.51	0.57	0.63	0.72	0.83	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
16	0.12	0.17	0.24	0.32	0.39	0.46	0.53	0.59	0.64	0.74	0.84	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
18	0.12	0.18	0.25	0.32	0.40	0.47	0.54	0.60	0.65	0.75	0.85	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
20	0.12	0.18	0.25	0.33	0.40	0.48	0.54	0.61	0.66	0.75	0.85	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
25	0.12	0.18	0.26	0.34	0.42	0.49	0.56	0.62	0.68	0.77	0.87	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
30	0.12	0.19	0.26	0.35	0.43	0.50	0.57	0.63	0.69	0.78	0.87	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.18

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.19	0.27	0.35	0.43	0.51	0.58	0.64	0.70	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.13	0.19	0.27	0.36	0.44	0.51	0.58	0.65	0.70	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.13	0.19	0.27	0.36	0.44	0.52	0.59	0.65	0.71	0.80	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.13	0.19	0.28	0.36	0.44	0.52	0.59	0.65	0.71	0.80	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.13	0.19	0.28	0.37	0.45	0.53	0.60	0.66	0.72	0.80	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.13	0.19	0.28	0.37	0.45	0.53	0.60	0.66	0.72	0.81	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.13	0.20	0.28	0.37	0.45	0.53	0.60	0.67	0.72	0.81	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.13	0.20	0.28	0.37	0.46	0.54	0.61	0.67	0.72	0.81	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.13	0.20	0.28	0.37	0.46	0.54	0.61	0.67	0.73	0.81	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.13	0.20	0.29	0.38	0.47	0.55	0.62	0.68	0.74	0.82	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.13	0.20	0.29	0.38	0.47	0.55	0.62	0.68	0.74	0.83	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.13	0.20	0.29	0.38	0.47	0.55	0.62	0.69	0.74	0.83	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.13	0.20	0.29	0.38	0.47	0.55	0.62	0.69	0.74	0.83	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.13	0.20	0.29	0.39	0.47	0.55	0.62	0.69	0.74	0.83	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.19

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.0	0.12	0.13	0.15	0.17	0.19	0.21	0.26	0.32	0.43	0.53	0.61	0.76	0.85	0.99	1.00	1.00	1.00
2	0.0	0.11	0.13	0.17	0.20	0.23	0.27	0.31	0.34	0.41	0.51	0.66	0.77	0.85	0.94	0.98	1.00	1.00	1.00	1.00
4	0.10	0.13	0.18	0.23	0.29	0.34	0.39	0.45	0.50	0.59	0.70	0.84	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00
6	0.11	0.15	0.21	0.27	0.34	0.40	0.46	0.52	0.58	0.67	0.79	0.90	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
8	0.11	0.16	0.23	0.30	0.37	0.44	0.51	0.57	0.63	0.72	0.83	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
10	0.11	0.17	0.24	0.32	0.40	0.47	0.54	0.60	0.66	0.76	0.86	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
12	0.12	0.18	0.26	0.34	0.42	0.49	0.56	0.63	0.68	0.78	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.12	0.18	0.26	0.35	0.43	0.51	0.58	0.64	0.70	0.79	0.89	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.12	0.19	0.27	0.36	0.44	0.52	0.59	0.66	0.71	0.81	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.12	0.19	0.28	0.36	0.45	0.53	0.60	0.67	0.73	0.82	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.12	0.19	0.28	0.37	0.46	0.54	0.61	0.68	0.73	0.82	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.13	0.20	0.29	0.38	0.47	0.55	0.63	0.69	0.75	0.84	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.13	0.20	0.30	0.39	0.48	0.56	0.64	0.70	0.76	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.19

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.21	0.30	0.40	0.49	0.57	0.65	0.71	0.77	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.13	0.21	0.30	0.40	0.49	0.58	0.65	0.72	0.77	0.86	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.13	0.21	0.31	0.41	0.50	0.58	0.66	0.72	0.78	0.86	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.13	0.21	0.31	0.41	0.50	0.59	0.66	0.73	0.78	0.86	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.13	0.21	0.31	0.41	0.51	0.59	0.67	0.73	0.79	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.13	0.21	0.32	0.42	0.51	0.60	0.67	0.74	0.79	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.13	0.22	0.32	0.42	0.51	0.60	0.68	0.74	0.79	0.88	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.13	0.22	0.32	0.42	0.52	0.60	0.68	0.74	0.80	0.88	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.13	0.22	0.32	0.42	0.52	0.61	0.68	0.75	0.80	0.88	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.13	0.22	0.33	0.43	0.53	0.61	0.69	0.75	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.13	0.22	0.33	0.43	0.53	0.62	0.69	0.76	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.13	0.22	0.33	0.43	0.53	0.62	0.69	0.76	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.13	0.22	0.33	0.43	0.53	0.62	0.70	0.76	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.13	0.22	0.33	0.44	0.53	0.62	0.70	0.76	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.20

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.0	0.0	0.10	0.12	0.14	0.16	0.19	0.21	0.23	0.28	0.36	0.47	0.58	0.67	0.81	0.90	1.00	1.00	1.00	1.00
2	0.0	0.11	0.14	0.18	0.22	0.26	0.30	0.34	0.38	0.46	0.57	0.72	0.82	0.90	0.97	0.99	1.00	1.00	1.00	1.00
4	0.10	0.14	0.20	0.26	0.32	0.38	0.44	0.49	0.55	0.65	0.76	0.89	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
6	0.11	0.16	0.23	0.30	0.38	0.45	0.52	0.58	0.64	0.74	0.84	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
8	0.11	0.18	0.25	0.34	0.42	0.49	0.57	0.63	0.69	0.79	0.88	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.12	0.19	0.27	0.36	0.44	0.52	0.60	0.66	0.72	0.82	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.12	0.19	0.28	0.37	0.46	0.55	0.62	0.69	0.75	0.84	0.92	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.12	0.20	0.29	0.39	0.48	0.56	0.64	0.71	0.76	0.85	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.13	0.20	0.30	0.40	0.49	0.58	0.65	0.72	0.78	0.86	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.13	0.21	0.31	0.41	0.50	0.59	0.67	0.73	0.79	0.87	0.94	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.13	0.21	0.31	0.41	0.51	0.60	0.67	0.74	0.80	0.88	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.13	0.22	0.32	0.43	0.53	0.61	0.69	0.76	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.13	0.22	0.33	0.44	0.54	0.63	0.70	0.77	0.82	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.20

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.23	0.33	0.44	0.54	0.63	0.71	0.77	0.83	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.13	0.23	0.34	0.45	0.55	0.64	0.72	0.78	0.83	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.13	0.23	0.34	0.45	0.55	0.65	0.72	0.79	0.84	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.14	0.23	0.34	0.46	0.56	0.65	0.73	0.79	0.84	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.14	0.23	0.35	0.46	0.56	0.66	0.73	0.79	0.85	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.14	0.24	0.35	0.46	0.57	0.66	0.74	0.80	0.85	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.14	0.24	0.35	0.47	0.57	0.66	0.74	0.80	0.85	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.14	0.24	0.36	0.47	0.57	0.67	0.74	0.80	0.85	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.14	0.24	0.36	0.47	0.58	0.67	0.74	0.81	0.86	0.92	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.14	0.24	0.36	0.48	0.59	0.68	0.75	0.81	0.86	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.14	0.25	0.37	0.48	0.59	0.68	0.76	0.82	0.87	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.14	0.25	0.37	0.48	0.59	0.68	0.76	0.82	0.87	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.14	0.25	0.37	0.49	0.59	0.68	0.76	0.82	0.87	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.14	0.25	0.37	0.49	0.59	0.69	0.76	0.82	0.87	0.93	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.21

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0500. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.12	0.13	0.16	0.20	0.24	0.28	0.32	0.36	0.40	0.47	0.57	0.70	0.80	0.87	0.95	0.98	1.00	1.00	1.00	1.00
2	0.13	0.17	0.24	0.30	0.37	0.43	0.49	0.55	0.69	0.69	0.79	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
4	0.15	0.23	0.33	0.43	0.51	0.59	0.66	0.72	0.77	0.85	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.16	0.26	0.38	0.49	0.59	0.67	0.74	0.80	0.84	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.17	0.28	0.42	0.53	0.63	0.72	0.78	0.84	0.88	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.18	0.30	0.44	0.56	0.66	0.75	0.81	0.86	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.18	0.31	0.46	0.58	0.68	0.77	0.83	0.88	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.18	0.32	0.47	0.60	0.70	0.78	0.84	0.89	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.19	0.33	0.48	0.61	0.71	0.79	0.85	0.89	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.19	0.33	0.49	0.62	0.72	0.80	0.86	0.90	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.19	0.34	0.49	0.63	0.73	0.81	0.86	0.91	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.19	0.35	0.51	0.64	0.74	0.82	0.88	0.92	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.20	0.35	0.52	0.65	0.75	0.83	0.88	0.92	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.21

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.400,
AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.20	0.36	0.52	0.66	0.76	0.83	0.89	0.93	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.20	0.36	0.53	0.66	0.77	0.84	0.89	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.20	0.36	0.53	0.67	0.77	0.84	0.89	0.93	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.20	0.37	0.54	0.67	0.77	0.85	0.90	0.93	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.20	0.37	0.54	0.68	0.78	0.85	0.90	0.94	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.20	0.37	0.54	0.68	0.78	0.85	0.90	0.94	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.20	0.37	0.55	0.68	0.78	0.86	0.90	0.94	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.20	0.38	0.55	0.69	0.79	0.86	0.91	0.94	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.20	0.38	0.55	0.69	0.79	0.86	0.91	0.94	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.21	0.38	0.56	0.70	0.80	0.87	0.91	0.94	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.21	0.38	0.56	0.70	0.80	0.87	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.21	0.39	0.56	0.70	0.80	0.87	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.21	0.39	0.56	0.70	0.80	0.87	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.21	0.39	0.56	0.70	0.80	0.87	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.22

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.400,
AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.10	0.13	0.17	0.22	0.26	0.31	0.36	0.40	0.45	0.53	0.64	0.78	0.87	0.93	0.98	0.99	1.00	1.00	1.00	1.00
2	0.12	0.18	0.26	0.34	0.41	0.49	0.55	0.62	0.67	0.76	0.86	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
4	0.15	0.25	0.37	0.48	0.58	0.67	0.74	0.80	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.16	0.29	0.43	0.56	0.66	0.75	0.82	0.87	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.17	0.31	0.47	0.60	0.71	0.80	0.86	0.90	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.18	0.33	0.50	0.63	0.74	0.82	0.88	0.92	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.18	0.35	0.52	0.66	0.76	0.84	0.90	0.93	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.19	0.36	0.53	0.67	0.78	0.86	0.91	0.94	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.19	0.37	0.54	0.69	0.79	0.87	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.19	0.37	0.55	0.70	0.80	0.87	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.20	0.38	0.56	0.71	0.81	0.88	0.93	0.96	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.20	0.39	0.58	0.72	0.82	0.89	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.20	0.40	0.59	0.73	0.83	0.90	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.22

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.21	0.40	0.59	0.74	0.84	0.90	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.21	0.41	0.60	0.74	0.84	0.91	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.21	0.41	0.60	0.75	0.85	0.91	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.21	0.42	0.41	0.75	0.85	0.91	0.95	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.21	0.42	0.61	0.76	0.85	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.21	0.42	0.62	0.76	0.86	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.21	0.43	0.62	0.76	0.86	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.21	0.43	0.62	0.77	0.86	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.21	0.43	0.63	0.77	0.86	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.22	0.44	0.63	0.78	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.22	0.44	0.64	0.78	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.22	0.44	0.64	0.78	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.22	0.44	0.64	0.78	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.22	0.44	0.64	0.78	0.88	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.23

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0500. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.10	0.14	0.18	0.24	0.29	0.35	0.40	0.46	0.51	0.60	0.71	0.85	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00
2	0.12	0.20	0.29	0.38	0.47	0.55	0.62	0.69	0.75	0.83	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.15	0.28	0.42	0.54	0.65	0.74	0.81	0.87	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.17	0.33	0.49	0.63	0.74	0.82	0.88	0.92	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.19	0.36	0.53	0.68	0.79	0.86	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.19	0.38	0.57	0.71	0.82	0.89	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.20	0.40	0.59	0.73	0.84	0.90	0.94	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.21	0.41	0.61	0.75	0.85	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.21	0.42	0.62	0.76	0.86	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.21	0.43	0.63	0.77	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.22	0.44	0.64	0.78	0.88	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.22	0.45	0.65	0.80	0.89	0.94	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.23	0.46	0.67	0.81	0.90	0.95	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.23

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0500. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.23	0.47	0.67	0.81	0.90	0.95	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.23	0.47	0.68	0.82	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.23	0.48	0.68	0.82	0.91	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.23	0.48	0.69	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.24	0.49	0.69	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.24	0.49	0.70	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.24	0.49	0.70	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.24	0.49	0.70	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.24	0.50	0.71	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.25	0.50	0.72	0.85	0.93	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.25	0.51	0.72	0.85	0.93	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.25	0.51	0.72	0.85	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.25	0.51	0.72	0.85	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.25	0.51	0.72	0.86	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.24

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.0500, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.10	0.14	0.20	0.26	0.32	0.39	0.45	0.51	0.56	0.66	0.78	0.90	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
2	0.13	0.22	0.32	0.42	0.52	0.61	0.69	0.75	0.81	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.17	0.31	0.47	0.60	0.72	0.80	0.87	0.91	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.19	0.37	0.55	0.69	0.80	0.88	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.20	0.41	0.60	0.74	0.85	0.91	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.22	0.43	0.63	0.78	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.22	0.45	0.66	0.80	0.89	0.94	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.23	0.47	0.67	0.82	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.24	0.48	0.69	0.83	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.24	0.49	0.70	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.24	0.50	0.71	0.84	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.25	0.51	0.72	0.86	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.25	0.52	0.73	0.87	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.24

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.0500. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 5

	NUMBER OF UNITS																			
ENTITIES PER UNIT	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.26	0.53	0.74	0.87	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.26	0.54	0.75	0.88	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.26	0.54	0.75	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.26	0.54	0.76	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.27	0.55	0.76	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.27	0.55	0.77	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.27	0.56	0.77	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.27	0.56	0.77	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.27	0.56	0.77	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.28	0.57	0.78	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.28	0.57	0.79	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.28	0.58	0.79	0.91	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.28	0.58	0.79	0.91	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.28	0.58	0.79	0.91	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.25

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.13	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.15	0.16	0.18	0.20	0.24	0.27	0,42	0.65	0.94	1.00
2	0.14	0.12	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.18	0.21	0.24	0.27	0.32	0.37	0.59	0.84	0.99	1.00
4	0.14	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.20	0.22	0.27	0.31	0.35	0.42	0.49	0.74	0.94	1.00	1.00
6	0.14	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.20	0.22	0.25	0.30	0.34	0.39	0.47	0.55	0.80	0.97	1.00	1.00
8	0.14	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.21	0.23	0.26	0.32	0.37	0.42	0.51	0.58	0.83	0.98	1.00	1.00
10	0.14	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.24	0.27	0.33	0.39	0.44	0.53	0.61	0.86	0.98	1.00	1.00
12	0.14	0.13	0.14	0.15	0.17	0.18	0.19	0.21	0.22	0.24	0.28	0.34	0.40	0.45	0.55	0.63	0.87	0.99	1.00	1.00
14	0.14	0.13	0.14	0.16	0.17	0.18	0.20	0.21	0.22	0.25	0.29	0.35	0.41	0.46	0.56	0.64	0.88	0.99	1.00	1.00
16	0.14	0.13	0.14	0.16	0.17	0.19	0.20	0.21	0.23	0.25	0.29	0.36	0.42	0.47	0.57	0.65	0.89	0.99	1.00	1.00
18	0.14	0.14	0.15	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.30	0.36	0.42	0.48	0.58	0.66	0.89	0.99	1.00	1.00
20	0.14	0.14	0.15	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.30	0.37	0.43	0.48	0.58	0.67	0.90	0.99	1.00	1.00
25	0.14	0.14	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.27	0.31	0.38	0.44	0.49	0.59	0.68	0.91	0.99	1.00	1.00
30	0.14	0.14	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.27	0.31	0.38	0.44	0.50	0.60	0.69	0.91	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.25

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.100. AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.14	0.14	0.15	0.16	0.18	0.20	0.21	0.23	0.24	0.27	0.32	0.39	0.45	0.51	0.61	0.69	0.92	1.00	1.00	1.00
40	0.14	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.24	0.27	0.32	0.39	0.45	0.51	0.61	0.70	0.92	1.00	1.00	1.00
45	0.14	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.25	0.28	0.32	0.39	0.46	0.51	0.62	0.70	0.92	1.00	1.00	1.00
50	0.14	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.28	0.32	0.39	0.46	0.52	0.62	0.70	0.92	1.00	1.00	1.00
60	0.14	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.28	0.33	0.40	0.45	0.52	0.62	0.71	0.93	1.00	1.00	1.00
70	0.14	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.28	0.33	0.40	0.46	0.52	0.63	0.71	0.93	1.00	1.00	1.00
80	0.14	0.14	0.15	0.17	0.19	0.20	0.22	0.23	0.25	0.28	0.33	0.40	0.47	0.53	0.63	0.71	0.93	1.00	1.00	1.00
90	0.14	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.25	0.28	0.33	0.40	0.47	0.53	0.63	0.72	0.93	1.00	1.00	1.00
100	0.14	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.25	0.28	0.33	0.40	0.47	0.53	0.63	0.72	0.93	1.00	1.00	1.00
200	0.14	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.26	0.29	0.34	0.41	0.48	0.54	0.64	0.73	0.94	1.00	1.00	1.00
300	0.14	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.41	0.48	0.54	0.64	0.73	0.94	1.00	1.00	1.00
400	0.14	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.41	0.48	0.54	0.64	0.73	0.94	1.00	1.00	1.00
500	0.14	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.41	0.48	0.54	0.65	0.73	0.94	1.00	1.00	1.00
1000	0.14	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.41	0.48	0.54	0.65	0.73	0.94	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.26

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.12	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.15	0.17	0.19	0.21	0.25	0.28	0.45	0.71	0.97	1.00
2	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.15	0.16	0.17	0.19	0.22	0.25	0.28	0.34	0.40	0.64	0.89	1.00	1.00
4	0.13	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.18	0.20	0.23	0.28	0.32	0.37	0.45	0.53	0.79	0.97	1.00	1.00
6	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.26	0.31	0.37	0.42	0.51	0.59	0.86	0.99	1.00	1.00
8	0.13	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.24	0.28	0.34	0.39	0.45	0.55	0.63	0.89	0.99	1.00	1.00
10	0.13	0.13	0.14	0.16	0.17	0.18	0.19	0.21	0.22	0.25	0.29	0.35	0.41	0.47	0.57	0.66	0.91	1.00	1.00	1.00
12	0.13	0.13	0.14	0.16	0.17	0.19	0.20	0.21	0.23	0.26	0.30	0.36	0.43	0.49	0.59	0.68	0.92	1.00	1.00	1.00
14	0.13	0.13	0.15	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.30	0.37	0.44	0.50	0.61	0.69	0.93	1.00	1.00	1.00
16	0.13	0.14	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.27	0.31	0.38	0.45	0.51	0.62	0.71	0.93	1.00	1.00	1.00
18	0.13	0.14	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.27	0.31	0.39	0.45	0.52	0.62	0.71	0.94	1.00	1.00	1.00
20	0.13	0.14	0.15	0.16	0.18	0.20	0.21	0.23	0.24	0.27	0.32	0.39	0.46	0.52	0.63	0.72	0.94	1.00	1.00	1.00
25	0.13	0.14	0.15	0.17	0.18	0.20	0.21	0.23	0.25	0.28	0.33	0.40	0.47	0.53	0.65	0.73	0.95	1.00	1.00	1.00
30	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.28	0.33	0.41	0.48	0.54	0.65	0.74	0.95	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.26

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.25	0.29	0.33	0.41	0.48	0.55	0.66	0.75	0.96	1.00	1.00	1.00
40	0.13	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.25	0.29	0.34	0.41	0.49	0.55	0.67	0.76	0.96	1.00	1.00	1.00
45	0.13	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.26	0.29	0.34	0.42	0.49	0.56	0.67	0.76	0.96	1.00	1.00	1.00
50	0.13	0.14	0.15	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.42	0.49	0.56	0.67	0.76	0.96	1.00	1.00	1.00
60	0.13	0.14	0.16	0.17	0.19	0.21	0.22	0.24	0.26	0.29	0.34	0.42	0.50	0.56	0.68	0.77	0.96	1.00	1.00	1.00
70	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.24	0.26	0.30	0.35	0.43	0.50	0.57	0.68	0.77	0.96	1.00	1.00	1.00
80	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.24	0.26	0.30	0.35	0.43	0.50	0.57	0.68	0.77	0.97	1.00	1.00	1.00
90	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.24	0.26	0.30	0.35	0.43	0.50	0.57	0.69	0.78	0.97	1.00	1.00	1.00
100	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.25	0.26	0.30	0.35	0.43	0.51	0.57	0.69	0.78	0.97	1.00	1.00	1.00
200	0.14	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.30	0.35	0.44	0.51	0.58	0.70	0.78	0.97	1.00	1.00	1.00
300	0.14	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.30	0.36	0.44	0.52	0.58	0.70	0.79	0.97	1.00	1.00	1.00
400	0.14	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.30	0.36	0.44	0.52	0.58	0.70	0.79	0.97	1.00	1.00	1.00
500	0.14	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.30	0.36	0.44	0.52	0.59	0.70	0.79	0.97	1.00	1.00	1.00
1000	0.14	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.31	0.36	0.44	0.52	0.59	0.70	0.79	0.97	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.27

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.12	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.14	0.16	0.18	0.20	0.22	0.26	0.30	0.49	0.77	0.99	1.00
2	0.12	0.12	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.19	0.23	0.26	0.30	0.37	0.43	0.69	0.93	1.00	1.00
4	0.12	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.21	0.24	0.30	0.35	0.40	0.49	0.57	0.85	0.99	1.00	1.00
6	0.12	0.13	0.14	0.15	0.16	0.17	0.19	0.20	0.21	0.24	0.27	0.33	0.39	0.45	0.56	0.65	0.90	1.00	1.00	1.00
8	0.13	0.13	0.14	0.15	0.17	0.18	0.20	0.21	0.22	0.25	0.29	0.36	0.43	0.49	0.60	0.69	0.93	1.00	1.00	1.00
10	0.13	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.31	0.38	0.45	0.51	0.62	0.72	0.95	1.00	1.00	1.00
12	0.13	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.27	0.32	0.39	0.46	0.53	0.64	0.74	0.95	1.00	1.00	1.00
14	0.13	0.14	0.15	0.16	0.18	0.20	0.21	0.23	0.24	0.28	0.32	0.40	0.47	0.54	0.66	0.75	0.96	1.00	1.00	1.00
16	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.28	0.33	0.41	0.48	0.55	0.67	0.76	0.96	1.00	1.00	1.00
18	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.24	0.25	0.29	0.34	0.42	0.49	0.56	0.68	0.77	0.97	1.00	1.00	1.00
20	0.13	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.26	0.29	0.34	0.42	0.50	0.57	0.69	0.78	0.97	1.00	1.00	1.00
25	0.13	0.14	0.15	0.17	0.19	0.21	0.22	0.24	0.26	0.30	0.35	0.43	0.51	0.58	0.70	0.79	0.97	1.00	1.00	1.00
30	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.25	0.26	0.30	0.35	0.44	0.52	0.59	0.71	0.80	0.98	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.27

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100,
AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.25	0.27	0.30	0.36	0.45	0.53	0.60	0.72	0.81	0.98	1.00	1.00	1.00
40	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.25	0.27	0.31	0.36	0.45	0.53	0.60	0.72	0.81	0.98	1.00	1.00	1.00
45	0.13	0.14	0.16	0.18	0.19	0.21	0.23	0.25	0.27	0.31	0.36	0.45	0.53	0.61	0.73	0.82	0.98	1.00	1.00	1.00
50	0.13	0.14	0.16	0.18	0.20	0.21	0.23	0.25	0.27	0.31	0.37	0.46	0.54	0.61	0.73	0.82	0.98	1.00	1.00	1.00
60	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.27	0.31	0.37	0.46	0.54	0.61	0.73	0.82	0.98	1.00	1.00	1.00
70	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.37	0.46	0.54	0.62	0.74	0.83	0.98	1.00	1.00	1.00
80	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.37	0.46	0.55	0.62	0.74	0.83	0.98	1.00	1.00	1.00
90	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.47	0.55	0.62	0.74	0.83	0.98	1.00	1.00	1.00
100	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.47	0.55	0.62	0.75	0.83	0.99	1.00	1.00	1.00
200	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.47	0.56	0.63	0.75	0.84	0.99	1.00	1.00	1.00
300	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.48	0.56	0.64	0.76	0.84	0.99	1.00	1.00	1.00
400	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.33	0.38	0.48	0.56	0.64	0.76	0.84	0.99	1.00	1.00	1.00
500	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.33	0.39	0.48	0.56	0.64	0.76	0.84	0.99	1.00	1.00	1.00
1000	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.27	0.29	0.33	0.39	0.48	0.56	0.64	0.76	0.84	0.99	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.28

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.13	0.14	0.15	0.16	0.18	0.21	0.23	0.27	0.32	0.53	0.82	1.00	1.00
2	0.12	0.12	0.12	0.13	0.14	0.14	0.15	0.16	0.16	0.18	0.20	0.24	0.28	0.32	0.39	0.46	0.74	0.96	1.00	1.00
4	0.12	0.12	0.13	0.14	0.15	0.17	0.18	0.19	0.20	0.22	0.26	0.31	0.37	0.43	0.53	0.62	0.89	1.00	1.00	1.00
6	0.12	0.13	0.14	0.15	0.17	0.18	0.19	0.21	0.22	0.25	0.29	0.36	0.42	0.49	0.60	0.69	0.94	1.00	1.00	1.00
8	0.12	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.31	0.39	0.46	0.52	0.64	0.74	0.96	1.00	1.00	1.00
10	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.23	0.24	0.28	0.33	0.41	0.48	0.55	0.67	0.77	0.97	1.00	1.00	1.00
12	0.13	0.14	0.15	0.17	0.18	0.20	0.22	0.23	0.25	0.29	0.34	0.42	0.50	0.57	0.69	0.79	0.97	1.00	1.00	1.00
14	0.13	0.14	0.15	0.17	0.19	0.20	0.22	0.24	0.26	0.29	0.35	0.43	0.51	0.58	0.71	0.80	0.98	1.00	1.00	1.00
16	0.13	0.14	0.15	0.17	0.19	0.21	0.23	0.24	0.26	0.30	0.35	0.44	0.52	0.60	0.72	0.81	0.98	1.00	1.00	1.00
18	0.13	0.14	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.30	0.36	0.45	0.53	0.61	0.73	0.82	0.98	1.00	1.00	1.00
20	0.13	0.14	0.16	0.17	0.19	0.21	0.23	0.25	0.27	0.31	0.36	0.45	0.54	0.61	0.74	0.83	0.99	1.00	1.00	1.00
25	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.31	0.37	0.47	0.55	0.63	0.75	0.84	0.99	1.00	1.00	1.00
30	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.47	0.56	0.64	0.76	0.85	0.99	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.28

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.100, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.32	0.38	0.48	0.57	0.64	0.77	0.85	0.99	1.00	1.00	1.00
40	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.33	0.39	0.48	0.57	0.65	0.77	0.86	0.99	1.00	1.00	1.00
45	0.13	0.14	0.16	0.18	0.20	0.22	0.24	0.27	0.29	0.33	0.39	0.49	0.58	0.55	0.78	0.86	0.99	1.00	1.00	1.00
50	0.13	0.14	0.16	0.18	0.20	0.22	0.25	0.27	0.29	0.33	0.39	0.49	0.58	0.66	0.78	0.86	0.99	1.00	1.00	1.00
60	0.13	0.14	0.16	0.18	0.20	0.23	0.25	0.27	0.29	0.33	0.40	0.50	0.58	0.66	0.78	0.87	0.99	1.00	1.00	1.00
70	0.13	0.14	0.16	0.18	0.21	0.23	0.25	0.27	0.29	0.34	0.40	0.50	0.59	0.67	0.79	0.87	0.99	1.00	1.00	1.00
80	0.13	0.14	0.16	0.18	0.21	0.23	0.25	0.27	0.29	0.34	0.40	0.50	0.59	0.67	0.79	0.87	0.99	1.00	1.00	1.00
90	0.13	0.14	0.16	0.19	0.21	0.23	0.25	0.27	0.30	0.34	0.40	0.50	0.59	0.67	0.79	0.87	0.99	1.00	1.00	1.00
100	0.13	0.14	0.16	0.19	0.21	0.23	0.25	0.27	0.30	0.34	0.40	0.50	0.59	0.67	0.79	0.88	0.99	1.00	1.00	1.00
200	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.28	0.30	0.34	0.41	0.51	0.60	0.68	0.80	0.88	0.99	1.00	1.00	1.00
300	0.13	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.35	0.41	0.51	0.60	0.68	0.80	0.88	0.99	1.00	1.00	1.00
400	0.13	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.35	0.41	0.52	0.61	0.68	0.81	0.88	0.99	1.00	1.00	1.00
500	0.13	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.35	0.41	0.52	0.61	0.69	0.81	0.89	0.99	1.00	1.00	1.00
1000	0.13	0.15	0.17	0.19	0.21	0.23	0.26	0.28	0.30	0.35	0.41	0.52	0.61	0.69	0.81	0.89	0.99	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.29

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.250,
AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.15	0.15	0.17	0.19	0.21	0.23	0.25	0.28	0.30	0.34	0.39	0.48	0.56	0.62	0.73	0.81	0.97	1.00	1.00	1.00
2	0.16	0.18	0.21	0.25	0.28	0.32	0.35	0.38	0.41	0.47	0.55	0.66	0.74	0.81	0.90	0.95	1.00	1.00	1.00	1.00
4	0.18	0.22	0.27	0.32	0.37	0.41	0.46	0.50	0.54	0.61	0.69	0.80	0.88	0.92	0.97	0.99	1.00	1.00	1.00	1.00
6	0.19	0.24	0.30	0.36	0.41	0.47	0.52	0.56	0.60	0.67	0.76	0.86	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00
8	0.19	0.25	0.32	0.38	0.44	0.50	0.55	0.60	0.64	0.71	0.80	0.89	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00
10	0.20	0.26	0.33	0.40	0.47	0.52	0.57	0.62	0.67	0.74	0.82	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00
12	0.20	0.27	0.34	0.42	0.48	0.54	0.59	0.64	0.68	0.76	0.84	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
14	0.20	0.27	0.35	0.43	0.49	0.55	0.61	0.65	0.70	0.77	0.85	0.93	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00
16	0.20	0.28	0.36	0.43	0.50	0.56	0.62	0.66	0.71	0.78	0.86	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
18	0.20	0.28	0.36	0.44	0.51	0.57	0.62	0.67	0.72	0.79	0.86	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
20	0.21	0.28	0.37	0.44	0.51	0.58	0.63	0.68	0.72	0.79	0.87	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
25	0.21	0.29	0.38	0.45	0.52	0.59	0.64	0.69	0.73	0.80	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
30	0.21	0.29	0.38	0.46	0.53	0.60	0.65	0.70	0.74	0.81	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.29

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.21	0.30	0.39	0.47	0.54	0.60	0.66	0.71	0.75	0.82	0.89	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
40	0.21	0.30	0.39	0.47	0.54	0.61	0.66	0.71	0.75	0.82	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
45	0.21	0.30	0.39	0.47	0.55	0.61	0.67	0.72	0.76	0.83	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
50	0.21	0.30	0.39	0.48	0.55	0.61	0.67	0.72	0.76	0.83	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
60	0.21	0.30	0.40	0.48	0.55	0.62	0.67	0.72	0.76	0.83	0.90	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
70	0.22	0.31	0.40	0.48	0.56	0.62	0.68	0.73	0.77	0.84	0.90	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00
80	0.22	0.31	0.40	0.48	0.56	0.62	0.68	0.73	0.77	0.84	0.90	0.96	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00
90	0.22	0.31	0.40	0.49	0.56	0.63	0.68	0.73	0.77	0.84	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.22	0.31	0.40	0.49	0.56	0.63	0.68	0.73	0.77	0.84	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.22	0.31	0.41	0.49	0.57	0.63	0.69	0.74	0.78	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.22	0.31	0.41	0.50	0.57	0.64	0.69	0.74	0.78	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.22	0.31	0.41	0.50	0.57	0.64	0.69	0.74	0.78	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.22	0.32	0.41	0.50	0.57	0.64	0.69	0.74	0.78	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.22	0.32	0.41	0.50	0.57	0.64	0.70	0.74	0.79	0.85	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.30

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.250, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.14	0.15	0.17	0.20	0.22	0.24	0.27	0.29	0.31	0.36	0.42	0.52	0.60	0.68	0.79	0.87	0.99	1.00	1.00	1.00
2	0.15	0.18	0.22	0.26	0.30	0.33	0.37	0.41	0.44	0.51	0.59	0.71	0.80	0.86	0.94	0.98	1.00	1.00	1.00	1.00
4	0.17	0.22	0.28	0.33	0.39	0.44	0.49	0.54	0.58	0.66	0.75	0.86	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00
6	0.18	0.24	0.31	0.38	0.44	0.50	0.55	0.60	0.65	0.73	0.82	0.91	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
8	0.19	0.26	0.33	0.41	0.47	0.54	0.59	0.65	0.69	0.77	0.85	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00
10	0.19	0.27	0.35	0.43	0.50	0.56	0.62	0.67	0.72	0.80	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
12	0.19	0.28	0.36	0.44	0.51	0.58	0.64	0.69	0.74	0.81	0.89	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
14	0.20	0.28	0.37	0.45	0.53	0.59	0.65	0.71	0.75	0.83	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.20	0.29	0.38	0.46	0.54	0.61	0.67	0.72	0.76	0.84	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.20	0.29	0.38	0.47	0.55	0.61	0.67	0.73	0.77	0.84	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.20	0.29	0.39	0.47	0.55	0.62	0.68	0.73	0.78	0.85	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.20	0.30	0.40	0.49	0.56	0.63	0.70	0.75	0.79	0.86	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.21	0.30	0.40	0.49	0.57	0.64	0.70	0.76	0.80	0.87	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.30

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.21	0.31	0.41	0.50	0.58	0.65	0.71	0.76	0.81	0.87	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.21	0.31	0.41	0.50	0.58	0.66	0.72	0.77	0.81	0.88	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.21	0.31	0.41	0.51	0.59	0.66	0.72	0.77	0.81	0.88	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.21	0.31	0.42	0.51	0.59	0.66	0.72	0.77	0.82	0.88	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.21	0.32	0.42	0.51	0.60	0.67	0.73	0.78	0.82	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.21	0.32	0.42	0.52	0.60	0.67	0.73	0.78	0.83	0.89	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.21	0.32	0.42	0.52	0.60	0.67	0.73	0.79	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.21	0.32	0.43	0.52	0.60	0.68	0.74	0.79	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.21	0.32	0.43	0.52	0.61	0.68	0.74	0.79	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.22	0.33	0.43	0.53	0.61	0.69	0.75	0.80	0.84	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.22	0.33	0.44	0.53	0.62	0.69	0.75	0.80	0.84	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.22	0.33	0.44	0.53	0.62	0.69	0.75	0.80	0.84	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.22	0.33	0.44	0.53	0.62	0.69	0.75	0.80	0.84	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.22	0.33	0.44	0.54	0.62	0.69	0.75	0.80	0.84	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.31

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.14	0.15	0.18	0.20	0.23	0.26	0.28	0.31	0.33	0.38	0.45	0.56	0.65	0.73	0.84	0.91	1.00	1.00	1.00	1.00
2	0.15	0.19	0.23	0.27	0.32	0.36	0.40	0.44	0.48	0.55	0.64	0.77	0.85	0.91	0.97	0.99	1.00	1.00	1.00	1.00
4	0.17	0.23	0.30	0.36	0.42	0.48	0.53	0.58	0.63	0.71	0.81	0.91	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
6	0.18	0.26	0.33	0.41	0.48	0.55	0.60	0.66	0.71	0.79	0.87	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
8	0.19	0.27	0.36	0.44	0.52	0.59	0.65	0.70	0.75	0.83	0.90	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.19	0.28	0.38	0.46	0.54	0.61	0.68	0.73	0.78	0.85	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.20	0.29	0.39	0.48	0.56	0.63	0.70	0.75	0.80	0.87	0.93	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.20	0.30	0.40	0.49	0.58	0.65	0.71	0.76	0.81	0.88	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.20	0.31	0.41	0.50	0.59	0.66	0.72	0.78	0.82	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.21	0.31	0.42	0.51	0.60	0.67	0.73	0.78	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.21	0.31	0.42	0.52	0.60	0.68	0.74	0.79	0.83	0.90	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.21	0.32	0.43	0.53	0.62	0.69	0.75	0.80	0.85	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.21	0.33	0.44	0.54	0.63	0.70	0.76	0.81	0.85	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.31

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.22	0.33	0.44	0.54	0.63	0.71	0.77	0.82	0.86	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.22	0.33	0.45	0.55	0.64	0.71	0.77	0.82	0.86	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.22	0.34	0.45	0.55	0.64	0.72	0.78	0.83	0.87	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.22	0.34	0.45	0.56	0.65	0.72	0.78	0.83	0.87	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.22	0.34	0.46	0.56	0.65	0.72	0.79	0.84	0.87	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.22	0.34	0.46	0.56	0.65	0.73	0.79	0.84	0.88	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.22	0.34	0.46	0.57	0.66	0.73	0.79	0.84	0.88	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.22	0.35	0.46	0.57	0.66	0.73	0.79	0.84	0.88	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.22	0.35	0.47	0.57	0.66	0.74	0.80	0.84	0.88	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.23	0.35	0.47	0.58	0.67	0.74	0.80	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.23	0.35	0.47	0.58	0.67	0.75	0.81	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.23	0.35	0.48	0.58	0.67	0.75	0.81	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.23	0.35	0.48	0.58	0.67	0.75	0.81	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.23	0.36	0.48	0.58	0.68	0.75	0.81	0.86	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.32

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.250,
AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.14	0.16	0.18	0.21	0.24	0.27	0.30	0.33	0.36	0.41	0.49	0.61	0.70	0.78	0.89	0.94	1.00	1.00	1.00	1.00
2	0.15	0.19	0.24	0.29	0.34	0.38	0.43	0.47	0.52	0.59	0.69	0.82	0.90	0.94	0.98	1.00	1.00	1.00	1.00	1.00
4	0.17	0.24	0.31	0.39	0.45	0.52	0.58	0.63	0.68	0.76	0.85	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
6	0.19	0.27	9.36	0.44	0.52	0.59	0.65	0.71	0.76	0.83	0.91	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.20	0.29	0.39	0.48	0.56	0.63	0.70	0.75	0.80	0.87	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.20	0.30	0.41	0.50	0.59	0.66	0.73	0.78	0.83	0.89	0.95	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.21	0.31	0.42	0.52	0.61	0.68	0.75	0.80	0.84	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.21	0.32	0.43	0.53	0.62	0.70	0.76	0.81	0.86	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.21	0.33	0.44	0.54	0.63	0.71	0.77	0.82	0.87	0.92	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.22	0.33	0.45	0.55	0.64	0.72	0.78	0.83	0.87	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.22	0.34	0.45	0.56	0.65	0.73	0.79	0.84	0.88	0.93	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.22	0.35	0.47	0.57	0.66	0.74	0.80	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.22	0.35	0.47	0.58	0.67	0.75	0.81	0.86	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.32

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.250. AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.23	0.36	0.48	0.59	0.68	0.76	0.82	0.86	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.23	0.36	0.48	0.59	0.69	0.76	0.82	0.87	0.90	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.23	0.36	0.49	0.60	0.69	0.77	0.83	0.87	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.23	0.36	0.49	0.60	0.70	0.77	0.83	0.88	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.23	0.37	0.50	0.61	0.70	0.78	0.83	0.88	0.91	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.23	0.37	0.50	0.61	0.70	0.78	0.84	0.88	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.23	0.37	0.50	0.61	0.71	0.78	0.84	0.88	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.23	0.37	0.50	0.62	0.71	0.78	0.84	0.89	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.24	0.37	0.50	0.62	0.71	0.79	0.84	0.89	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.24	0.38	0.51	0.63	0.72	0.79	0.85	0.89	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.24	0.38	0.51	0.63	0.72	0.80	0.85	0.89	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.24	0.38	0.52	0.63	0.72	0.80	0.85	0.90	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.24	0.38	0.52	0.63	0.72	0.80	0.85	0.90	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.24	0.38	0.52	0.63	0.73	0.80	0.86	0.90	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.33

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.18	0.22	0.27	0.32	0.37	0.42	0.47	0.51	0.55	0.62	0.70	0.81	0.88	0.93	0.97	0.99	1.00	1.00	1.00	1.00
2	0.21	0.29	0.37	0.45	0.52	0.58	0.64	0.69	0.73	0.80	0.88	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
4	0.24	0.37	0.49	0.58	0.67	0.73	0.79	0.83	0.87	0.92	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.26	0.41	0.55	0.65	0.73	0.80	0.85	0.89	0.91	0.95	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.28	0.44	0.58	0.69	0.77	0.83	0.88	0.91	0.94	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.29	0.46	0.61	0.71	0.79	0.85	0.90	0.93	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.29	0.48	0.62	0.73	0.81	0.87	0.91	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.30	0.49	0.64	0.75	0.82	0.88	0.92	0.94	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.30	0.50	0.65	0.76	0.83	0.89	0.92	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.31	0.50	0.66	0.76	0.84	0.89	0.93	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.31	0.51	0.66	0.77	0.85	0.90	0.93	0.96	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.32	0.52	0.67	0.78	0.86	0.91	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.32	0.53	0.68	0.79	0.86	0.91	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.33

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200. THE LEVEL OF SIGNIFICANCE IS 0.1000. THE EFFECT SIZE IS 0.400. AND THE NUMBER OF LEVELS IS 2

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.32	0.53	0.69	0.80	0.87	0.92	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.33	0.54	0.69	0.80	0.87	0.92	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.33	0.54	0.70	0.80	0.87	0.92	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.33	0.54	0.70	0.81	0.88	0.92	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.33	0.55	0.71	0.81	0.88	0.93	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.33	0.55	0.71	0.81	0.88	0.93	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.33	0.55	0.71	0.82	0.88	0.93	0.96	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.33	0.56	0.71	0.82	0.89	0.93	0.96	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.33	0.56	0.72	0.82	0.89	0.93	0.96	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.34	0.56	0.72	0.83	0.89	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.34	0.57	0.72	0.83	0.89	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.34	0.57	0.73	0.83	0.89	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.34	0.57	0.73	0.83	0.90	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.34	0.57	0.73	0.83	0.90	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.34

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.17	0.22	0.28	0.34	0.40	0.45	0.50	0.55	0.59	0.67	0.76	0.87	0.93	0.96	0.99	1.00	1.00	1.00	1.00	1.00
2	0.20	0.30	0.39	0.48	0.56	0.63	0.69	0.74	0.79	0.86	0.92	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.24	0.39	0.52	0.63	0.72	0.79	0.84	0.89	0.92	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.27	0.44	0.59	0.70	0.79	0.85	0.90	0.93	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.28	0.47	0.63	0.74	0.83	0.89	0.93	0.95	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.30	0.50	0.65	0.77	0.85	0.90	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.30	0.51	0.67	0.79	0.87	0.92	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.31	0.52	0.69	0.80	0.88	0.93	0.96	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.32	0.53	0.70	0.81	0.89	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.32	0.54	0.71	0.82	0.89	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.32	0.55	0.72	0.83	0.90	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.33	0.56	0.73	0.84	0.91	0.95	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.34	0.57	0.74	0.85	0.91	0.95	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.34

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE
LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400,
AND THE NUMBER OF LEVELS IS 3

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.34	0.58	0.74	0.85	0.92	0.95	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.34	0.58	0.75	0.86	0.92	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.34	0.59	0.75	0.86	0.92	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.35	0.59	0.76	0.86	0.92	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.35	0.59	0.76	0.87	0.93	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.35	0.60	0.77	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.35	0.60	0.77	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.35	0.60	0.77	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.35	0.60	0.77	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.36	0.61	0.78	0.88	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.36	0.61	0.78	0.88	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.36	0.61	0.78	0.88	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.36	0.61	0.78	0.88	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.36	0.62	0.78	0.88	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.35

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.17	0.23	0.30	0.37	0.43	0.49	0.54	0.59	0.64	0.72	0.82	0.91	0.96	0.98	1.00	1.00	1.00	1.00	1.00	1.00
2	0.21	0.32	0.43	0.53	0.61	0.69	0.75	0.80	0.84	0.90	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.26	0.42	0.57	0.69	0.78	0.84	0.89	0.93	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.29	0.48	0.64	0.76	0.84	0.90	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.31	0.52	0.69	0.80	0.88	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.32	0.55	0.71	0.83	0.90	0.94	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.33	0.56	0.73	0.85	0.91	0.95	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.34	0.58	0.75	0.86	0.92	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.35	0.59	0.76	0.87	0.93	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.35	0.60	0.77	0.87	0.93	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.35	0.60	0.78	0.88	0.94	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.36	0.62	0.79	0.89	0.95	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.37	0.63	0.80	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.35

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 4

ENTITIES PER UNIT	NUMBER OF UNITS 2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
35	0.37	0.63	0.80	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
40	0.38	0.64	0.81	0.91	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.38	0.64	0.81	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	0.38	0.65	0.82	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	0.38	0.65	0.82	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
70	0.39	0.66	0.82	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.39	0.66	0.83	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.39	0.66	0.83	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
100	0.39	0.66	0.83	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
200	0.40	0.67	0.84	0.92	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
300	0.40	0.67	0.84	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
400	0.40	0.67	0.84	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
500	0.40	0.68	0.84	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1000	0.40	0.68	0.84	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.

TABLE 4.5.36

STATISTICAL POWER[1] WHEN THE INTRACLASS CORRELATION IS 0.200, THE LEVEL OF SIGNIFICANCE IS 0.1000, THE EFFECT SIZE IS 0.400, AND THE NUMBER OF LEVELS IS 5

ENTITIES PER UNIT	NUMBER OF UNITS																			
	2	3	4	5	6	7	8	9	10	12	15	20	25	30	40	50	100	200	500	1000
1	0.18	0.25	0.32	0.39	0.46	0.53	0.59	0.64	0.69	0.77	0.86	0.94	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00
2	0.22	0.34	0.46	0.57	0.66	0.74	0.80	0.85	0.89	0.94	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	0.28	0.46	0.62	0.74	0.83	0.89	0.93	0.96	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	0.31	0.53	0.69	0.81	0.89	0.94	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	0.33	0.57	0.74	0.85	0.92	0.96	0.98	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	0.35	0.59	0.77	0.87	0.93	0.97	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	0.36	0.61	0.79	0.89	0.95	0.97	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	0.37	0.63	0.80	0.90	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
16	0.38	0.64	0.81	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
18	0.38	0.65	0.82	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	0.39	0.66	0.83	0.92	0.96	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	0.40	0.67	0.84	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30	0.40	0.68	0.85	0.93	0.97	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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[1] POWER VALUES LESS THAN .10 WERE SET AT 0.0 BECAUSE VERY SMALL POWER VALUES WERE OCCASIONALLY INACCURATE.